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SUPREME COURT OF THE UNITED STATES.

No. 209.

THE UNION WATER METER COMPANY, APPELLANT,

vs.

WILLIAM E. DESPER AND HENRY A. DESPER.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE DISTRICT OF MASSACHUSETTS.

FILED OCTOBER 3, 1877.

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1 UNITED STATES OF AMERICA,
Massachusetts District, ss:

At a circuit court of the United States for the first circuit, begun and holden at Boston, within and for the district of Massachusetts, on Tuesday, the fifteenth day of May, in the year of our Lord one thousand eight hundred and seventy-seven, before the honorable George F. Shepley, circuit judge.

UNION WATER METER COMPANY, COMPLAINANT,
v.
WILLIAM E. DESPER ET AL., DEFENDANTS. } In equity.

1*a* The bill of complaint in this cause was filed in the clerk's office on the twenty-ninth day of December, A. D. 1875, and was duly entered at the October term of this court, A. D. 1875, and is in the words and figures following, namely:

1*b* *Bill of complaint.*

To the honorable the justices of the circuit court of the United States for the district of Massachusetts:

The Union Water Meter Company, a corporation duly organized under and in accordance with the general laws of the State of Massachusetts, and located and doing business at the city of Worcester, in said State, brings this its bill of complaint against William E. Desper & Co., doing business in the aforesaid city of Worcester, State of Massachusetts, and Henry A. Desper and William E. Desper, citizens of the State of Massachusetts, residing at Worcester, in said State, and thereupon your orator complains and says:

That Phinehas Ball and Benaiah Fitts, citizens of the United States, residing at the city of Worcester aforesaid, were the original, first and joint inventors of certain new and useful improvements in liquid meters not known or used before their invention thereof, and which were not at the time of their application for letters patent therefor, as hereinafter mentioned, in public use or on sale with their consent or allowance.

And your orators, on information and belief, further show unto your honors that the said Phinehas Ball and Benaiah Fitts, being
2 so as aforesaid the original, first, and joint inventors of said improvements, did, on the twenty-second day of November, 1870, upon due application therefor, obtain letters patent of the United States for said invention and improvements in due form of law, under the seal of the Patent Office of the United States, signed by W. T. Otto, Acting Secretary of the Interior, and countersigned by Samuel A. Duncan, Acting Commissioner of Patents of the United States, bearing date the twenty-second day of November, 1870, and numbered 109372, whereby there was granted and secured to the said Phinehas Ball and Benaiah Fitts, their executors, administrators, or assigns, for the term of seventeen years from and after the date of said letters patent, the full and exclusive right and liberty of making, using, and vending to others to be used, the said invention and improvements as set forth in said letters patent, all of which, in and by a certified copy of said letters patent, in court to be produced and shown your honors, will more fully and at large appear.

And your orator further shows that a certain assignment was made by the said Phinehas Ball and Benaiah Fitts, and duly recorded in the Patent Office of the United States on the 17th day of February, 1872, in Liber V[14], folio 286, of Transfers of Patents, whereby your orator, the Union Water Meter Company, became the legal owner of the entire interest in said patent granted to said Phinehas Ball and Benaiah Fitts, as aforesaid, as by reference to the same, or to a certified copy in court to be produced and shown your honors, will more more fully and at large appear.

And your orator further shows unto your honors that the said Phinehas Ball and Benaiah Fitts, for good and lawful cause, surrendered said letters patent to the Commissioner of Patents, in which surrender your orator, the Union Water Meter Company, did concur; and having made due application therefor, and having in all things complied with the acts of Congress in such case made and provided, the Commissioner of Patents did issue to the said Union Water Meter Company, as the assignee of the said Phinehas Ball and Benaiah Fitts, new letters patent of the United States for the aforesaid invention and improvements, in due form of law, under the seal of the Patent Office of the United States,
3 signed by B. R. Cowen, Acting Secretary of the Interior, and countersigned by M. D. Leggett, Commissioner of Patents of the United States, and bearing date the twenty-fourth day of March, 1874, and numbered reissue 5086, granting unto your orator, the said Union Water Meter Company, its successors or assigns, for the term of seventeen years, from the twenty-second day of November, 1870, the full and exclusive right of making, using, and vending to others to be used, the said invention and improvements, as by said reissued patent or a certified copy thereof, to be in court produced and shown your honors, will more fully and at large appear.

That by virtue of the premises your orator, the said Union Water Meter Company, became, and has ever since been, the sole and exclusive owner of said letters patent and of the improvements and invention therein described, and of all the rights, privileges and interests thereby granted and secured; and that your orator has been at great trouble and expense in and about said invention for the purpose of carrying on the business of making, using, and vending to others to be used, the said improvements and invention, and in making the same profitable and useful to the public. That said invention and improvements are of great value to your orator, and would be of much greater value and profit if it were not for the wrongful acts of the defendants as hereinafter set forth.

Yet the defendants, well knowing the premises and the rights secured to your orator, as aforesaid, but contriving to injure and deprive your orator of the profits, benefits and advantages which would otherwise accrue from the inventions and improvements so secured to it by the aforesaid letters patent, did, at Worcester, in the State of Massachusetts aforesaid, and before the commencement of this suit, as your orator is informed and believes, and without license or consent of your orator, and in violation of your orator's rights, and infringement of said letters patent and of the invention and improvements thereby secured, unlawfully and wrongfully make, construct and use, and vend to others to be used, a large number of water, fluid, or liquid meters (how many your orator cannot state, but prays that the defendants may discover and set forth), according to, and which embodied in their construction and mode of operation the invention and improvements secured to and owned by your orator and as set forth in the said reissued patent No. 5806,

4 and claimed in the first seven claims thereof. And that the said defendants still make, use and vend, or procure to be made, vended or used, liquid or fluid meters which embody the aforesaid improvements without your orator's consent or allowance, and without right and in violation and infringement of said letters patent and your orator's exclusive rights as aforesaid, and thereby said defendants have infringed and are still infringing and preparing to infringe, and cause your orator to fear that in future they will infringe, upon the exclusive rights and privileges secured to your orator as aforesaid.

Your orator further shows that the defendants have derived and received, and are still deriving and receiving from such unlawful making, vending and use large gains and profits, but to what amount your orator is ignorant, but prays that the defendants may be required to make full disclosure and accounting.

Your orator further shows that the said defendants have been notified of the exclusive rights so secured to your orator by said reissued letters patent, and that they were infringing the same, and the said defendants have been requested to refrain from their said unlawful acts, but that the defendants have disregarded said notice and have refused to desist therefrom, and refused to pay to or account with your orator for the profits which have inured to them from such wrongful use.

That your orator has been greatly damaged and injured by the wrongful acts of the defendants, and but for the wrongful acts of the defendants would have made large gains and profits and advantages from the manufacture, use and sale of meters embodying said invention and improvements, and will receive large gains, profits and advantages therefrom if the infringement by said defendants be prevented, but that the use of said invention and improvements by said defendants as aforesaid, and their making, using and vending the said meters as aforesaid, and their preparation for and avowed determination to continue the same, and their other aforesaid unlawful acts in disregard of the rights of your orator, deprives your orator of such gains and profits, and has the effect to encourage and induce others to infringe said patent to the great loss and injury of your orator, the said Union Water Meter Company.

Your orator, therefore, prays that the said defendants, William
5 E. Desper & Co., Henry A. Desper, and William E. Desper, their workmen, salesmen, clerks, and all others their servants and agents, may be severally perpetually enjoined and restrained by the decree of this honorable court from directly or indirectly making, using or vending to others to use, delivering, working or putting in practical operation or use, or in anywise counterfeiting or imitating the said improvements and invention secured to your orator by said reissued letters patent, or any meters containing or embodying the aforesaid invention or improvements, or made in accordance therewith, or like or similar to the meters they have heretofore made and are now making, and from infringing upon or violating said invention and letters-patent in any way.

And that the defendants may be compelled by the decree of this honorable court to account for and pay over to the said Union Water Meter Company all such gains and profits as have been received by, or have accrued to them in any way from their use of the invention as aforesaid, and in addition to such profits, to be accounted for by the defendants, the damages which have been sustained by the said Union Water Meter Company by the infringement and other unlawful acts of

the defendants to be assessed by the court, or under its direction, and that the court do increase said damages threefold.

And that the defendants be decreed to pay the costs of this suit, and that your orator may have such other and further relief as to this honorable court shall seem meet and shall be agreeable to equity.

To the end, therefore, that the said defendants may show if they can why your orator should not have the relief hereby prayed, and upon their corporal oath and according to their best and utmost knowledge, information, and belief, full, true, direct and perfect answer make to the several matters and things hereinbefore averred as fully and particularly as if specifically interrogated as to each and every of said matters—

May it please your honors to grant unto your orator the writ of subpœna ad respondendum, issuing out of and under the seal of this honorable court, directed to the said defendants, William E. Desper & Co., Henry A. Desper, and William E. Desper, commanding
6 them by a certain day, and under a certain penalty, to be and appear in this honorable court, then and there to answer to this bill of complaint, and to abide by and perform such order and decree as may be made herein against them.

And your orator will ever pray, etc.

UNION WATER METER COMPANY,
By PHINEHAS BALL,
President Union Water Meter Company.

A. MCCALLUM,
Solicitor for Complainants.
HANNAY & MCCALLUM,
of Counsel.

UNITED STATES OF AMERICA,
District of Massachusetts:

Upon this twenty-ninth day of December, 1875, before me personally appeared Phinehas Ball, president of the Union Water Meter Company, the above-named complainant, who, being by me duly sworn, deposes and says, that he has read the foregoing bill of complaint subscribed by him and knows the contents thereof, and that the same is true of his own knowledge, except as to the matters herein stated upon information and belief, and as to those matters he believes it to be true.

[SEAL.] JOHN G. STETSON,
U. S. Commissioner.

On the first day of March, A. D. 1876, answer was filed, and afterwards, by consent of parties, was amended, which answer (the amendment being in brackets) is as follows:

Answer.

These defendants, answering said bill of complaint, or so much thereof as they are advised it is material for them to answer, jointly and severally say—

1. That upon information and belief they admit that letters patent, dated Nov. 22, 1870, for alleged "Improvements in liquid meters," were granted to Phinehas Ball and Benaiah Fitts, and that
7 the same were surrendered and reissued, as alleged in said bill of complaint.

2. But they deny that the same was surrendered for good and lawful

cause, or that the said reissued patent was for the invention described and shown in the original patent, and aver,

3. That it is far alleged inventions or improvements in liquid meters, described in and covered by letters patent granted to said Ball and Fitts on the 20th of July, 1869, and is therefore void.

4. They deny that the said Ball and Fitts were the first and original inventors of the combinations and arrangements described in said reissued patent, and aver that the same, or material and substantial parts thereof, claimed as new, are described in letters patent of the United States, granted to John Ericsson, of the city of New York, dated Jan. 1, 1851, and numbered 7869; also to John Hartin, dated May 24, 1853, and numbered 9746; also to John S. Barden, Oct. 21, 1862, and numbered 36698; also to John S. Barden, Oct. 24, 1865, and numbered 50651; also to J. Sutherland, June 2, 1868, and numbered 78551; *[also to H. R. Worthington, July 24, 1855, and numbered 13320; also to Elihu Spencer and E. L. Mayer, June 12, 1866, and numbered 55547; also to James Harris, Jan. 8, 1869, and numbered 85656; also to Henry C. Sergeant, assignor to William Tobin, Aug. 30, 1870, and numbered 106878; also that the things patented to said Ball and Fitts by the reissued letters patent in said bill mentioned were known to and used by H. R. Worthington, at Brooklyn, in the State of New York, who now resides at the same place, and by James Harris, who now resides in Cambridge, in this district.]

5. That they deny that they have ever made, used, or vended to others to be used, any water meters which embodied in their construction and mode of operation the improvements secured to or owned by the said complainant, as set forth in said reissued patent, as alleged in said bill of complaint, or that they are now making, or procuring and using or vending, any water meter which embodies the aforesaid alleged improvements, and they aver,

6. That every water meter made or sold by them was and is
8 made, constructed and operated in the manner described in letters patent of the United States granted to one of these defendant, Henry A. Desper, dated Nov. 18, 1873, and numbered 144747, for "Improvements in fluid meters," as the inventor thereof, with the exception that in the meters made by these defendants, instead of the adjusting screw K, as shown in the patent, a plug is inserted and cut off.

All which these defendants are ready to aver, maintain, and prove as this honorable court shall direct, and pray to be hence dismissed with their costs in this behalf sustained.

WILLIAM E. DESPER.
HENRY A. DESPER.

DISTRICT OF MASSACHUSETTS, *ss:*

Subscribed and affirmed before me, by William E. Desper and Henry A. Desper, this twenty-eighth day of February, A. D. 1876.

J. HENRY HILL,
U. S. Commissioner.

On the seventeenth day of March, A. D. 1876, the following replication was filed, namely:

*Part in brackets added by amendment, Jan. 13, 1877.

Replication.

The complainant hereby joins issue with the defendants.

A. McCALLUM,
Solicitor for Complainant.

8*a* This cause was thence continued from term to term to this present term, when, on the twenty-fourth day of May, A. D. 1877, publication of the testimony having passed in the clerk's office by consent, the cause is set down for hearing and fully heard by the court.

And now, to wit, June 7th, 1877, it is adjudged by the court that said defendants do not infringe in manner and form as alleged by said complainants in their said bill of complaint, and it is ordered, adjudged and decreed that said bill of complaint be and the same hereby is dismissed, with costs to said defendants taxed at——

From this decree the said complainants, in open court, claim and appeal to the Supreme Court of the United States, and give good and sufficient security to prosecute their said appeal to effect and answer
8*b* all damages and costs if they fail to make their plea good, and said security being approved by the court, said appeal is allowed accordingly.

A true record. Attest:

JOHN G. STETSON, *Clerk.*

9 The following is the evidence used in the hearing of said cause before said circuit court, namely:

EVIDENCE FOR COMPLAINANTS.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States in equity, as amended, before me.

JOHN G. STETSON, *Examiner.*

Present, Andrew McCallum, esq., of counsel for complainants; James E. Maynadier, esq., of counsel for defendants.

BOSTON, *Nov.* 20, 1876.

Counsel for complainants produces and puts in evidence the certified copies of the following papers, namely:

Letters patent of the United States, No. 109372, granted Phineas Ball and Benaiah Fitts, Nov. 22, 1870, for "Improvement in liquid meters," marked Complainants' Exhibit 1, J. G. S., Examiner.

Assignment of said last-named patent, marked Complainants' Exhibit 2, J. G. S., Examiner.

Certificate of incorporation of Union Water Meter Company, marked Complainants' Exhibit 3, J. G. S., Examiner.

Letters patent of the United States, reissue No. 5806, granted Phineas Ball and Benaiah Fitts, March 24, 1874, for "Improvement in liquid meters," marked Complainants' Exhibit 4, J. G. S., Examiner.

Counsel for complainants also produces and puts in evidence two water meters marked, respectively, Complainants' Exhibit 5, J. G. S., Examiner, and Complainants' Exhibit 6, J. G. S., Examiner.

Attest:

JOHN G. STETSON, *Examiner.*

10 *Complainants' Exhibit* 1.—*J. G. S., Examiner.*

Letters patent of the United States, No. 109372, granted Phinehas Ball and Benaiah Fitts, Nov. 22, 1870. Improvement in liquid meters.

The schedule referred to in these letters patent, and making part of the same.

To all whom it may concern:

Be it known that we, Phinehas Ball and Benaiah Fitts, of the city and county of Worcester and State of Massachusetts, have invented a new and useful improvement in water meters; and we do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawing making a part of this specification, in which—

Figure 1 is a plan, a portion of the machine being removed to show the inside.

Figure 2 is a sectional view through *x y*, Fig. 1.

It will be seen that this meter is similar in its operation to that patented by P. Ball and B. Fitts, July, 1869, the principal difference being in the slots in the connecting-rods, in which crank-pins move, and it is these slots, in connection with stops at the end of the cylinders, that constitute the peculiar features of this invention.

The construction is as follows:

a is the outside case.

b b are cylinders set in cement.

c c are pistons.

d d are connecting-rods, connecting the pistons together.

e is a slot in the connecting-rods. It will be seen that the sides of this slot are not parallel or straight, the slots being wider in the middle than at the ends.

(Here follows diagram marked page 10.)

11 *g* is a valve.

i is a shaft.

m is a crank.

n, a crank-pin, which moves in slot *e*.

o o are stops for the purpose of stopping the pistons when they reach the end of the stroke.

s s are ports through the valve, the pistons, shaft, and valve being so connected together that the valve-ports will be open when the piston is in the centre of the stroke and closed at the end of the stroke.

The operation is as follows:

As the water flows in and moves the pistons it will be seen that, by the peculiar form of slot *e*, the piston reaches the end of the stroke, and stops a little before the crank passes the centre (shown by the position in Fig. 2) or the valve-ports quite close. The opposite piston then moves the valve over, and opens it to the other side of the piston before the crank-pin reaches the point to where the first piston would be compelled to move, and thus in no case would one piston force the other to move while its valve is closed.

Thus having set forth our invention,

What we claim as new, and desire to secure by letters patent, is—

1. The piston-carrying connecting-rods *d*, having slots formed as shown with concavities to the right and left of the centre, in combination with the stops *o o*, substantially as set forth, and operating as described.

2. The piston-carrying connecting-rods *d*, having slots formed, as shown, in combination with crank *m* and crank-pin *n*, constructed and operating substantially as set forth and described.

PHINEHAS BALL.
BENAIAH FITTS.

Witnesses:
JOHN C. OTIS.
ABRAHAM FITTS.

12 *Complainants' Exhibit 2.—J. G. S., Examiner.*

DEPARTMENT OF THE INTERIOR,
U. S. PATENT OFFICE.

To all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the records of this office of an assignment recorded in Liber V[14], page 286.

In testimony whereof I, W. H. Doolittle, Acting Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed this tenth day of November, in the year of our Lord one thousand eight hundred and seventy-six, and of the Independence of the United States the one hundred and first.

[SEAL.]

W. H. DOOLITTLE,
Acting Commissioner.

[5. 5. Jan. 23, '72. 5. 5.]

Whereas we, Phinehas Ball and Benaiah Fitts, of Worcester, in the County of Worcester and State of Massachusetts, did obtain letters patent of the United States for improvement in liquid meters, which letters patent bears date the twenty-second day of November, 1870; and

Whereas the Union Water Meter Company, a corporation duly established by law, and having its place of business in the city of Worcester, are desirous of acquiring all our right, title, and interest therein:

Now, this indenture witnesseth, that for and in consideration of one dollar and other good and valuable considerations to us, the said Ball and Fitts, paid by said Union Water Meter Company, receipt whereof is hereby acknowledged, we do hereby sell, convey, transfer and reassign to the said Union Water Meter Company the said letters patent and invention thereby secured and all our right, title, and interest into and under the same. To have and to hold to them, the said Union Water Meter Company, their legal representatives and assigns, to their use to the full end of the term for which said letters patent are or may be granted as fully and entirely as the same would have been held and enjoyed by us had this grant and sale not been made.

13 Witness our hands and seals this twenty-third day of January, eighteen hundred and seventy-two.

PHINEHAS BALL. [SEAL.]
BENAIAH FITTS. [SEAL.]

In presence of—
ABIEL E. WILSON.

Recorded Feb. 17, 1872.

Complainants' Exhibit 3.—J. G. S., Examiner.

COMMONWEALTH OF MASSACHUSETTS:

Be it known, that whereas Phinehas Ball, Benaiah Fitts, Abraham

Fitts, and John C. Otis have formally associated themselves with the intention of forming a corporation under the name of the Union Water Meter Company, for the purpose to manufacture and sell liquid meters, water and steam moters, plumbing materials and steam fixtures, to buy, sell, own, and deal in any real or personal property necessary or convenient for the prosecution of said business, and generally to do all things incidental to said business, or to the proper management thereof, under the provisions of chapter sixty-one of the General Statutes, with a capital of seventy-five thousand dollars, and the provisions of the statutes of this commonwealth in such case made and provided have been complied with, as appears from the certificate of the president, treasurer, and directors of said corporation, duly approved by the commissioner of corporations, and recorded in this office:

Now, therefore, I, Oliver Warner, secretary of the commonwealth of Massachusetts, do hereby certify that said Union Water Meter Company is legally organized and established as an existing corporation, with the powers, rights, and privileges, and subject to the limitations, duties, and restrictions which by law appertain thereto.

Witness my official signature hereunto subscribed, and the seal of the commonwealth of Massachusetts hereunto affixed, this seventh day of August, in the year of our Lord one thousand eight hundred and seventy-five.

[L. S.]

OLIVER WARNER,
Secretary of the Commonwealth.

14

COMMONWEALTH OF MASSACHUSETTS,
SECRETARY'S DEPARTMENT,
Boston, November 9, 1876.

I hereby certify that the foregoing is a true copy of the certificate of incorporation of the Union Water Meter Company, reorganized under the provisions of chapter two hundred and twenty-four of the acts of the year eighteen hundred and seventy, having "the force and effect of a special charter," as appears by the records of this department.

Witness the seal of the commonwealth.

[SEAL.]

HENRY B. PEIRCE,
Secretary of the Commonwealth.

Complainants' Exhibit 4.—J. G. S., Examiner.

Letters patent of the United States, reissue No. 5806, granted Phinehas Ball and Benajah Fitts, assignors to the Union Water Meter Company, March 24, 1874. Improvement in liquid meters.

Specification forming part of letters patent No. 109372, dated November 22, 1870; reissue No. 5806, dated March 24, 1874; application filed February 26, 1874.

To all whom it may concern:

Be it known that we, Phinehas Ball and Benaiah Fitts, of Worcester, in the county of Worcester and State of Massachusetts, have invented certain new and useful improvements in liquid meters; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

(Here follow 2 diagrams, marked page 14)

Figure 1 represents a plan of a meter having our improvements applied thereto, a portion of the machine being cut off on the line of its length on one side to show the operative parts. Fig. 2 represents a vertical longitudinal section of the same, taken through the line *x x* of Fig. 1, a portion of the parts, however, being shown in elevation; and Fig. 3, a cross-section through the line *y y* of the same figure. Fig. 4 represents a sectional elevation along the line of the machine cut off in Fig. 1.

Our improvement relates to a new and improved mode of operating that class of water or fluid meters in which two or more cylinders, each provided with a reciprocating piston, are combined and used in connection with a single rotary valve, whose ports are common to the waterways of the different cylinders.

Our invention consists, first, in combining, with a rotary valve and a crank-shaft to operate it, a double-acting piston, working in a cylinder suitably constructed to receive and discharge at each end the liquid to be measured, when said piston carries a rod provided with a single cam-slot, formed and arranged at an angle to the path of motion of the piston, for the actuation of the crank-shaft through which motion is imparted from the piston to the valve, as the former is moved back and forth under the pressure of the water being measured.

Our invention also consists in combining, with a rotary valve and a crank-shaft to operate it, two double-acting pistons, each working in a separate cylinder, and each carrying a rod provided with a cam-slot formed and arranged at an angle to the path of motion of the piston, for the actuation of the crank-shaft through which motion is imparted from the pistons to the valve, as the pistons move back and forth under the pressure of the water being measured.

Our invention further consists in combining, with a rotary valve and crank-shaft to operate it, and with a double-acting piston, adjusting-stops so arranged that when used in connection with a piston-rod provided with a cam-slot formed at an angle to the path of motion of the piston, and of a proper width, the said slot shall suffice to permit of the adjustment of the pistons, that the cylinders may discharge at each end alternately, neither more nor less than the exact quantity of water required; and shall also suffice, when the further advance of the piston shall have been thus arrested by the stops, to permit the crank to turn without acting on, or being acted on by, its own piston, as, for instance, when its crank-shaft is acted on by the adjoining piston for the purpose of opening the ports to the other sides of the piston just stopped, and which it otherwise could not do were the slot not widened sufficiently for that purpose.

Our improvement also consists in modifying the form of the widened slot in the piston-rods, by providing it on either side, at or near its middle, with a curved depression or cavity, that the following results or operations may be obtained, to wit: First, that each piston may be stopped a little before its valve-ports quite close, and yet allow its crank and crank-pin to be turned over past their dead-center without acting on, or being acted on by, its own piston by the action of the adjoining piston, and so that the latter, in thus turning the crank, may also move the valve over and open its ports to the other sides of the piston just stopped, and that before the crank-pin of the latter piston has reached the point at which, under the action of the other piston, it would compel its own piston to move, thereby preventing the one piston from compelling the other to move while its valve-ports are closed; secondly, that the piston just stopped, when moving on its return stroke,

may sooner re-enforce the adjoining piston in its action on the crank-shaft, that the motion of the valve and piston may be more uniform and even, the re-enforcement coming at the time most required, that is to say, at the point at which the crank of the then actuating piston nears its dead-centre, and consequently at the point in which the cam-slot exerts the least power on it.

To enable others skilled in the art to make, construct, and use our improved meter, we will now proceed to describe it in detail, omitting a particular description of such parts of the meter as are unnecessary to a full and perfect understanding of our present improvements.

Our improvements are represented as being applied to a meter having an outside casing, *a*, in which are arranged four short sectional or auxiliary cylinders set in cement, *z*. These cylinders are arranged side by side, in pairs, each pair being concentric the one with the other, so as to form a single working cylinder, *b* or *b'*. Each sectional cylinder is provided with a piston; and the two pistons of each concentric pair of cylinders are so connected together by means of a piston-rod, *d*, as to form a single double-acting piston, *c* or *c'*. Each of the piston or connecting rods *d* is provided with a slot, *e*, into which the wrist-pin *n* of the crank *m* of the shaft *i*, that operates the valve *g*, projects and moves.

It will be seen, first, that we make the general width of the slot *e* somewhat greater than the diameter of the wrist-pin *n*; and secondly, that its width is still further enlarged on each side, at or near its centre, as shown at *r*, being the points necessary to allow the crank to turn freely over after the piston has been stopped. This form is deemed better than where the slot is made of an equal width throughout its length; for, as the distance between the straight portions of the slot is less than between the curved portions, and as it at that point is so made as to be still sufficiently wide to allow the crank to be turned far enough over to open the valve ports in reverse order to the other sides of the piston without acting on the piston so as to cause it to move on its return stroke before its valve-ports are open, it being less wide enables the piston on its return stroke sooner to re-enforce the other piston in turning the crank-shaft than it would were it of uniform width throughout its length. The shaft *i*, is provided with two cranks *m*, and crank-pins *n*, one of each for each connecting rod *d* and piston *c* or *c'*, it also carries a bevel-pinion, *q*, which meshes with a bevel-gear, *r*, formed on, or otherwise secured to, the valve *g*, and thereby imparts rotary motion to the latter as it itself is turned by the action of the pistons as they are moved back and forth, through the medium of rods *d*, slots *e*, cranks *m*, and crank-pins *n*, under the pressure of the water. The valve *g* is provided with ports, as well for the induction of the liquid to be measured as for the discharge of the same, and which for this purpose communicate with suitable channels *f f'*, leading to the interior of the measuring cylinders *b b'*, on the side of the pistons next the stops *o*. *s s* represent the induction ports; the eduction ports are not shown in the drawings, nor is such deemed necessary, as the rotary valve itself may be of any suitable construction so long as it is provided with the necessary ports through the channels *f* and *f'* to supply the liquid to and discharge it from the cylinders when measured. The measured liquid escapes from the machine through the channel *h*, while the water to be measured is fed into the machine through the channel *i*. Each end of the pistons *c* and *c'* is provided with an adjusting stop, *o*, with a view of abutting at the end of each stroke against the inner face of the cylinder-head, or head of the outer

casing. A projecting point, o', is represented as being formed on the casing for this purpose. These stops are for the purpose of adjusting the length of the stroke of the piston, so that each cylinder shall discharge, alternately, for each stroke of its double-acting piston, as nearly as possible, a given quantity of water and no more; and in addition to this we so arrange the crank and valve-ports with relation to each double-acting piston, that the latter will reach the end of its stroke and be arrested by the stop o, before its valve ports quite close. Thus arrested, the other double-acting piston, through its crank, and which is set at an angle of ninety degrees to the other, or thereabouts, then moves the valve over and opens its ports, but in reverse order to the other side of the piston just stopped before the crank-pin of the latter reaches the point at which it would compel its own piston to move, thus, in no case allowing the one double-acting piston to force the other to move while its valve ports are closed. This peculiar movement of the crank and valve we obtain through the agency of the widened slot. The rotary valve g and its ports are common to the four channels or water-ways which lead to and from the four ends of the two cylinders b and b', and which serve alternately to charge and discharge each end of these cylinders, and in so doing to move the pistons c and c', and their respective rods d d' back and forth, first moving the one, then the other, and after reversing the first and then the other, and so on alternately and successively. Two of these water-ways are shown at f and f' in Fig. 3, the one, f, communicating with the one end of cylinder b, at the point shown by the arrows in Fig. 2, and the other, f', communicating with the other cylinder, b', as shown by the arrows in Fig. 4; the two other corresponding water-ways of these cylinders being arranged at their other end, and respectively marked f and f' in Figs. 2 and 4. These channels,
19 according as the valve is moved, are, through it, alternately brought into communication with the supply pipe i and discharge pipe h of the meter. The discharge pipe for this purpose is so arranged as to communicate through a suitable opening with the eduction ports of the valve g. Each of the four water-ways f f and f' f' is separate and distinct, the one from the other, and all so arranged, as before stated, as to communicate with the ports of the rotary valve, according as the latter is turned.

The adjustment of the length of stroke of the piston, in order to discharge a given quantity of water, is effected by interposing a greater or less number of washers, w, between the pistons and the adjusting stops, as indicated in the drawings; or washers of different thickness may be used. When the proper thickness is attained, the stops are then screwed up tight.

Having thus described our invention, what we claim as new and desire to secure by letters patent, is—

1. The combination in a liquid meter of the following instrumentalities, to wit, a rotary valve, g, provided with suitable ports or openings, through which the liquid to be measured can be supplied to the meter and discharged therefrom; a cylinder b or b', for the reception and measurement of the liquid; and a double-acting piston, c or c', carrying a rod, d, said rod being provided with a single cam-slot, e, arranged as described, through which and a crank-shaft, i, rotary motion is communicated to the valve for the purposes set forth.

2. The combination in a liquid meter of the following instrumentalities, to wit, a rotary valve, g, provided with suitable ports or openings, through which the liquid to be measured can be supplied to the meter and discharged therefrom; the cylinders b and b', for the reception and

measurement of the liquid; and two double-acting pistons, *c* and *c'*, each carrying a rod, *d*, and each of said rods provided with a single cam-slot, *e*, arranged as described, through which and a crank-shaft, *i*, rotary motion is imparted to the valve in the manner and for the purposes substantially as set forth.

3. The combination in a liquid meter of the following instrumentalities, to wit, a rotary valve, *g*, provided with suitable ports or openings, through which the liquid to be measured can be supplied to the
20 meter and discharged therefrom; a cylinder, *b* or *b'*, for the reception and measurement of the liquid; a double-acting piston, *c* or *c'*, carrying a rod, *d*, provided with a single cam-slot *e*, arranged as described, and of a width greater than the diameter of the wrist *n* of the crank-shaft, to permit the adjustment of the length of stroke of the piston, that it may discharge at each stroke, as nearly as possible, a given quantity of water, and to permit its crank-wrist freely to pass the dead-centre after its own piston has ceased to act upon it; adjusting stops, *o*, by means of which the adjustment of the length of stroke of the piston at either end is effected; and, lastly, of a crank-shaft, *i*, through which motion from the piston is imparted to the valve, the whole operating in the manner substantially described.

4. The combination in a liquid meter of the following instrumentalities, to wit, a rotary valve, *g*, provided with suitable ports or openings, through which the liquid to be measured can be supplied to the meter and discharged therefrom; two cylinders, *b* and *b'*, for the reception and measurement of the liquid; the double-acting pistons, *c* and *c'*, each carrying a rod, *d*, and each of these provided with a single cam-slot, *e*, arranged as described, and of a width greater than the diameter of the wrist *n* of the crank-shaft, so as to permit of the adjustment of the pistons, that they may discharge at each stroke, as nearly as possible, the exact quantity of water required of them, and so as to allow each of the crank-wrists *n* freely to pass its dead-centre after its own piston has ceased to act on it; adjusting stops *o*, by means of which the adjustment of the length of the stroke of the pistons at either end is effected; and, lastly, a crank-shaft, *i*, through which motion from the pistons is imparted to the valves, the whole operating in the manner substantially as described.

5. The combination in a water or liquid meter of a piston-carrying connecting-rod, *d*, having a cam-slot, *e*, formed as shown, that is to say, at an angle to the path of motion of the rod and piston, and of a width greater than the diameter of the wrist *n* of the crank, which moves in and is actuated by it, with adjusting stops *o*, for the purpose set forth.

6. The combination in a water or liquid meter of two double-acting pistons, *c* and *c'*, and of their respective rods *d d*, each of the latter
21 being provided with a cam-slot, *e*, formed as shown, that is to say, at an angle to the path of motion of the piston and rod, and of a width greater than the diameter of the wrist *n* of the crank, which moves in and is actuated by it, with a crank-shaft, *i*, and adjusting stops *o*, so that each of the pistons may be independently adjusted without interfering with the motion of the other, substantially as set forth.

7. In a water or liquid meter, a piston-carrying connecting-rod, *d*, provided with a single slot, *e*, arranged as described, and used in connection with adjusting-stops *o*, shaft *i*, crank *m*, and crank-pin *n*, for the purpose set forth.

8. In a water or liquid meter, a piston-carrying rod, *d*, having a slot, *e*, formed as shown, that is to say, with a concavity, *v*, on each side, at

or near its middle, and used in connection with a crank-shaft, for the purpose set forth.

In testimony that we claim the foregoing we have hereunto set our hands and seals this 2d day of February, 1874.

PHINEHAS BALL. [L. S.]
BENAIAH FITTS. [L. S.]

Witnesses:
ABIEL E. WILSON.
JONAS HEALD.

Deposition of Benjamin F. Parkhurst.

BOSTON, *Nov.* 20, 1876.

Direct examination by ANDREW MCCALLUM, esq., of counsel for complainants.

Int. 1. Please state your name, age, residence, and occupation.

Ans. Benjamin F. Parkhurst; forty-eight; Worcester, Mass.; foreman of public water-works of Worcester, most of the time.

Int. 2. Do you know William E. Desper, of Worcester, Mass.?

Ans. I do.

(Defendants here admit that Exhibit 6 is a fair sample of the water meters made and sold by them, and that Exhibit 6 was made and sold by them to the witness.)

(No cross-examination.)

BENJ. F. PARKHURST.

Attest:
JOHN G. STETSON, *Examiner.*

22 *Deposition of John C. Otis.*

BOSTON, *Nov.* 20, 1876.

Direct examination by ANDREW MCCALLUM, esq., of counsel of complainants.

Int. 1. Please state your name, age, residence, and occupation.

Ans. John C. Otis; fifty-two; Worcester, Mass.; treasurer of the Union Water Meter Company.

Int. 2. Do you know the defendants, William E. Desper & Co.?

Ans. I do.

Int. 3. What business are they engaged in?

Ans. Manufacturing water meters.

Int. 4. Have you given the defendants notice that they were infringing letters patent No. 109372, dated Nov. 22, 1870, and reissued March 24, 1874, No. 5806, granted to Ball and Fitts for "Improvements in liquid meters"?

Ans. I gave them notice that the manufacturing of the meters they were making was an infringement on patents owned by the Union Water Meter Company.

(No cross-examination.)

JOHN C. OTIS.

Attest:
JOHN G. STETSON, *Examiner.*

Deposition of Benaiah Fitts.

BOSTON, *Nov.* 20, 1876.

Direct examination by ANDREW MCCALLUM, esq., of counsel for complainants.

Int. 1. Please state your name, age, residence, and occupation.

Ans. Benaiah Fitts; fifty-five; Worcester, Mass.; mechanical engineer of the Union Water Meter Company.

Int. 2. State what practical experience, if any, you have had as a machinist?

Ans. I have been engaged for the last thirty years in designing and building machinery of various kinds.

Int. 3. How long have you been engaged in the manufacture of water meters?

Ans. About nine years.

23 Int. 4. Are you the same Benaiah Fitts who is named as the joint inventor with Phinehas Ball in letters patent No. 109372, dated Nov. 22, 1870, for "Improvement in liquid-meters," reissued March 24, 1874, No. 5806?

Ans. I am.

Int. 5. Have you ever made any meters like those described in said patent?

Ans. I have.

Int. 6. Please look at the meter Exhibit 5, and say whether or not that is one of the meters referred to in the last question and answer.

Ans. It is.

Int. 7. Please look at the meter Exhibit 6, and say whether or not you understand its construction and method of operation.

Ans. I believe I do.

Int. 8. Please compare the meter Exhibit 5 with meter Exhibit 6, and say whether or not you find any similarity between them, either as to the construction of the parts or their method of operation.

(Objected to, because it has not yet appeared that Exhibit 5 is made in accordance with any patent or issue in this case.)

Ans. Meter Exhibit 5 consists of two double cylinders, in which are pistons, the pistons being connected together by a connecting-rod. The connecting-rods are provided with cam-slots at or near the centre, the cam-slots being at an angle to the path of the motion of the piston. There is a crank-shaft with cranks, with crank-pins which play in the cam-slots. The crank-pins are somewhat less in diameter than the width of the cam-slots. In the centre, between the pistons, is a rotary valve. In this rotary valve are ports, which, by the revolution of the valve, are opened and closed so as to charge and discharge the four cylinders. At the end of each piston there are stops which strike against the head of the piston. These stops serve to arrest the stroke of the piston, the object of these stops being to arrest the stroke; and by adjusting these stops the meter can be regulated to discharge a given amount of water. They also serve another purpose. Water being entirely incompressible, it is necessary that the piston should reach the end of the stroke and stop before the valve closes. The valve then passes along and
24 opens upon the other side before the piston is compelled to start. The slots in the connecting-rod being wider than the diameter of the crank-pin, allows of this adjustment.

As compared with Exhibit 5, we have here in Exhibit 6 two double cylinders, with pistons connected together with connecting-rods, the con-

necting-rods having cam-slots, the cam-slots wider than the crank-pins. In the centre we have a rotary-valve. At the ends of the cylinders we have stops. These stops arrest the pistons, allow of their being regulated to give a certain quantity of water, also allow the piston to stand still while the valve is being closed; all of which are substantially the same in their movements and operation as in Exhibit 5.

The valve in both instances is moved by the movement of the crank.

Int. 9. Can you designate the parts which you say are the same, or substantially the same, on both meters by letters or some other distinguishing marks? If you can, please do so.

Ans. I have designated corresponding parts by corresponding letters pasted upon them, A being the case, B the cylinder, C the piston, D the slotted connecting-rod, M the crank, and O the stops.

Int. 10. Is the meter Exhibit 5 constructed the same as the meter described in reissued letters patent 5806, before referred to?

Ans. It is.

Cross-examination by JAMES E. MAYNADIER, esq., of counsel for defendants:

Cross-int. 11. You are well aware, are you not, that water meters with two double cylinders, four pistons, each pair connected together, and the connecting-rod which connects one of the pair working a crank, the connecting-rod connecting the other pair working another crank, these two cranks one on one end and the other on the other end of a crank-shaft and the revolution of this crank-shaft working a rotary valve, were old and well known before the invention, if any, described in Exhibit 4?

Ans. No, sir; I am not.

Cross-int. 12. Are you not familiar with the patent granted to you and Ball in July, 1869?

Ans. I am.

Cross-int. 13. What difference, if any, is there between the meter, Exhibit 5, and that meter which you and Mr. Ball patented in 1869?

Ans. There are no cranks on that meter. The movement is made by two pins in the face plate, which forms a different motion somewhat. There are no stops in that meter except what is formed by the pins on the disks.

Cross-int. 14. That meter had two double cylinders, four pistons, each pair connected together, each connecting-rod working a crank, or what is the same thing, a disk with a wrist-pin projecting from its face, these two disks, one on one end and the other on the other end of a shaft, and the motion of the shaft working the valve, had it not?

(Objected to, for the reason that the patent of 1869 is not in evidence.)

Ans. No, sir.

Cross-int. 15. How many disks and how many wrist-pins were there in that meter? I mean the one made by you and Mr. Ball in 1869.

(Same objection.)

Ans. There were two disks, and two pins in each disk; four pins in all.

Cross-int. 16. Were not each pair of pistons in that 1869 meter connected together by a rigid connecting rod, with a slot across it near its middle?

(Same objection.)

Ans. No, sir.

Cross-int. 17. How did the connecting rods in that meter differ from the connecting rods in Exhibit 5, if at all?

(Same objection.)

Ans. There are two slots in each connecting rod; one pin played in one, the other played in the other.

26 Cross-int. 18. Do you believe that a meter constructed as shown in Exhibit 5, but with slots closed at the top and bottom, and of the proportions shown in Fig. 4 of the drawings of your reissue, would work at all?

Ans. Yes, sir.

Cross-int. 19. Could the crank shaft shown in Fig. 4 of those drawings make a single revolution with the connecting rod and the slot constructed as shown in that figure?

Ans. As far as the crank shaft goes, I don't see why it shouldn't. The whole drawing may not be a perfect working drawing, but this reduced drawing is substantially correct.

Cross-int. 20. Answer the same question as to Fig. 1 of the drawings.

Ans. That is not a working drawing. A portion is cut off to show the position. I see no reason why the crank wouldn't revolve.

Cross int. 21. Wouldn't the wrist-pin strike the top wall of the slot if you should try to revolve the crank in one direction, and the bottom wall of the slot if you should try to revolve it in the other, both in this drawing, Fig. 1, and in Fig. 4?

Ans. The top and bottom wall of the slot stands back of the crank-pin, as I understand it. The connecting-rod is cut away to show the position of the crank, as I understand it.

Cross-int. 22. What makes you think the connecting-rod is cut away? State fully everything that makes you think so.

Ans. The second paragraph of the text says, "A portion of the machine being cut off on the line of its length on one side to show the operative parts."

Cross-int. 23. Don't you know that relates to Fig. 2 of the drawings, and not to Fig. 1, and that the specification is wrong as to this, that is to say, that Fig. 2 of the drawings represents a plan of the meter, a portion cut off, etc., and Fig. 1 a vertical longitudinal section of the same, instead of vice versa, as the specification states?

Ans. Fig. 2 represents a plan with a portion cut off, and Fig. 1 is a vertical section. I didn't notice this when I gave my former answer.

27 Cross-int. 24. Isn't it clear now to you that with this slot with two sides and top and bottom, as shown in Figs. 1 and 4 of the drawings of the reissue, and with a crank as shown in those drawings, the crank-pin can only oscillate through about a third of a circle, and that the valve must be materially changed from the valve in Exhibit 5, becoming an oscillating valve, instead of a rotary one, and the meter be materially altered from the meter Exhibit 5, in that the pistons and their connecting-rods oscillate the crank-shaft and the valve, instead of rotating them?

Ans. Fig. 2 gives the plan form of the connecting-rod; the elevation doesn't give the plan form of it. This would be sufficient instruction to a person to make the connecting-rod so that the crank should pass round.

Cross-int. 25. (Question repeated.)

Ans. It is not clear to me that the meter would become an oscillating meter, or that the cranks would oscillate. Fig. 1 doesn't give sufficient information to make the connecting-rod; but when the whole drawing with its explanation is taken, I think it is clear enough to enable a person skilled in the art to make the meter.

Cross-int. 26. (Question repeated.)

(Defendants' counsel here states that the question does not relate to anything but Figs. 1 and 4, and is mainly how much of a circle the wrist-pin can move over when the crank and slots are constructed as shown in those figures.

Counsel for complainants repeats his objection to all questions involving the construction of this patent, there being nothing in the direct examination which authorizes such questions on cross-examination, and he further objects to the question respecting the drawing without reference to the description of the drawing contained in the specification, which description is necessary to a proper reading of the patent and understanding of the invention therein set forth.)

Ans. I am not able to see exactly how that connecting-rod would be formed, taking the drawing of only one view of it, or a view in elevation; therefore I am not able to answer the question further.

28 Cross-int. 27. Why were the original drawings altered so as to change the elevation of this slot?

(Same objection.)

Ans. It was believed by the inventors that the specification and claim and drawing were too limited. The invention really covered a broader ground than was claimed in the original patent.

Cross-int. 28. But my question is, why were the slots stopped up at the top and bottom, as shown in Figs. 1 and 4 of the reissued drawings, and shortened so as to prevent the revolution of the crank-shaft and make it oscillate, instead of revolve, and why were the curved depressions and cavities, shown in the original drawings and in Fig. 1 of the reissue, omitted in Fig. 4 of the reissue?

(Same objection, and the further objection that the question is misleading, there being nothing in the patent or in the testimony of the witness which shows that the revolution of the crank-shaft is prevented or changed from a rotary to an oscillating motion.)

Ans. Fig. 4 represents a sectional elevation along the line of the machine cut off in Fig. 1. I have before stated there seems to be a mistake in numbering Figs. 1 and 2. Fig. 4, being a section drawn along the line cut off in what should be Fig. 1, is a correct drawing showing the back side of the connecting-rod, a portion of it cut away to show the movement of the crank-pin. It does not therefore show that it is cut off or capped over. There seems to have been a slight mistake in drawing the full shape of the slot in the connecting-rod shown in Fig. 1. The line showing the walls of the slot should have been continued clear across the rod, as shown by dotted lines in the original drawing. There is therefore no cap to prevent the crank from making a complete revolution. The curvatures in the slot were not necessary to have the meter work well, and it is believed to be limiting the claim to specify exactly this form of slot, though it is believed the meter will work smoother with a little curve in the slot than if perfectly straight. The line on which Fig. 4 is a section is not through the slot of the connecting-rod; the curves therefore in the walls of that slot do not appear, it being the back of the slotted rod that is shown.

29 Cross-int. 29. The original drawings are all right, are they not?

Ans. I have not detected any particular mistake, so far as they go.

Cross-int. 30. Did not you ascertain, by using a meter in which wrist-pins worked in slots across connecting rods, that the wrist-pins were forced against the walls of the slots at the points where you make your curved depressions or cavities in the meter patented in 1870?

Ans. Not necessarily so, further than to come forward at their proper time to move the crank.

Cross-int. 31. You don't apprehend the question, which is, didn't you find, by using a meter without these curved depressions or cavities on either side of the slot, that the wrist-pins ground much more against these parts of the slots than anywhere else?

Ans. I did not.

Cross-int. 32. You never experienced any trouble of this kind with any meter?

Ans. A meter properly made and properly set up has never given me any trouble in that direction.

Cross-int. 33. I don't mean the meter described in the patent now sued on, but the meter used before you made these cavities in these slots.

(Counsel for complainants objects to any questions about meters not in evidence.)

Ans. Never had any difficulty in that direction.

Cross-int. 34. Suppose the slot shown in Fig. 1 were as wide all the way as it is across the concavity *e* in the patent, would that affect the operation of the meter; and, if so, how?

Ans. It would be necessary to set the valve a little different.

Cross-int. 35. Would it not also compel the piston to start back where the cylinder was full of water and before the exhaust port was open?

Ans. If it was properly adjusted to that position it would not, as it might be.

Cross-int. 36. Will you testify that meter Exhibit 5 could be adjusted properly to prevent this movement of piston against the water confined in the cylinder if the slot were as wide all the way as it now is in its widest part, the friction-roller on the wrist-pin remaining the same diameter it now is?

Ans. Yes, sir.

Cross-int. 37. How many revolutions does the crank shaft make in Exhibit 5 to one revolution of the valve, and how is this in your reissued patent?

Ans. It makes three.

Cross-int. 38. That is, there are ten teeth in the gear on the crank shaft, and thirty teeth in the gear on the valve. Is that what you mean?

Ans. Yes, sir.

Cross-int. 39. Does it makes any difference in your meter if the relation between the revolution of the crank-shaft and the valve be changed?

Ans. If it is changed it would be necessary to change the ports also.

Cross-int. 40. There are four ports in your valve seat and six ports in the valves. Will any other arrangement except one to three suit that valve and its seat?

Ans. I believe it can be made different, though I have never put any in practical operation. With six ports in the valve and four in the seat, the crank must revolve three times while the valve revolves once.

Cross-int. 41. Suppose the valve revolve once while the crank revolves twice, how would you arrange the ports in the valve and the valve-seat, if you could do it any way?

Ans. I have never made one in that form. This valve has three charge ports and three discharge ports; the seat has four ports, one leading to each cylinder. What is necessary is, that a charge port should be presented to one end of the cylinder, while an exhaust port is presented to the other end.

Cross-int. 42. You don't apprehend the question. Can you use that

meter, Exhibit 5, with fifteen teeth on the crank-shaft and thirty
31 on the valve, and you are at liberty to vary the ports any way you like?

Ans. I never have done it. I don't say it can't be done; I don't testify it can be done.

Cross-int. 43. Would it not ruin the operation of that meter if eleven or any other number but ten teeth were on the crank-shaft while there were thirty teeth on the valve?

Ans. Of course it would. I have shown the operation of the meter as described in the patent. I would state further that a different number than six ports, with a different relative speed of the shaft and valve, may be constructed to work successfully.

Cross-int. 44. How many teeth, so far as you can tell, are shown on the valve and on the crank-shaft in the drawings of your reissue?

Ans. There is only a part of each gear shown in one place. There are five teeth shown from the top view of the pinion on the crank-shaft. There are some twenty shown on the valve.

Cross-int. 45. I count twenty in less than half of the circle. Please look at it again and say how many there are on the whole valve. I also count seven on the crank-shaft exposed to view in Fig. 2.

(This question and the previous one objected to, as the drawing shows for itself.)

Ans. Sixteen are the most I can make on one side, and some of those lines are short and obscure. I don't make over six on the pinion.

Cross-int. 46. Can you see how a liquid meter having a rotary valve like Exhibit 5, a cylinder like one of the two cylinders in Exhibit 5, a pair of pistons like one of the pairs in Exhibit 5, a connecting rod like one of the two in Exhibit 5, provided with a slot as in Exhibit 5, and a crank-shaft like that in Exhibit 5, can operate at all?

Ans. Not without some additional appliance to take the place of the other cylinder, its piston, rod, etc. It would operate, so far as its functions are concerned, but would require something additional to make a complete meter.

Cross-int. 47. Would a water meter operate practically if con-
32 structed precisely like Exhibit 5, except that the slots in the connecting rods were all the way of a width, and the diameter of the friction roll on the wrist-pin were such that the roll would fit the slot without binding?

Ans. It would operate as long as all of its adjustments were perfectly made. As soon as there was a little wear it would become liable to become locked by the valve being closed and the piston compelled to move against the water in the cylinder, the question being understood to imply that the stops were so adjusted as to arrest the stroke of the piston.

Cross-int. 48. You can't conceive of any liquid meter which can be practically operated with only one cylinder like the two in Exhibit 5, one pair of pistons, one piston rod, and one slot, can you?

Ans. It would require a little additional appliance to operate in connection with these.

Cross-int. 49. What would be the effect of adjusting one stop in Exhibit 5, so that one side of the slot in the connecting rod should be carried as close as possible to the friction roll on the wrist-pin when the stop struck the piston head, and adjusting the stop in the other piston on the same rod, so that the other side of the slot would be as far as possible from the friction roll on the wrist-pin when its stop struck the piston head?

Ans. Something would depend on the manner of the adjustment of the valve, as the ports must be open as long as the piston is required to move. I think the valve could be fitted so that it would work for a time. As soon as it became worn it would become locked.

Cross-int. 50. Do you believe it would make any difference in the operation of Exhibit 6, if the wrist-pin fitted in the slots closely, but not so close as to bind?

Ans. It would not ordinarily, under an ordinary stream of clean water. The wrist-pin travels in a certain path without much strain or friction, but when one piston is obstructed a little by dirty water or other cause, then it would become liable to strain upon the pin.

Cross-int. 51. What would make that strain?

Ans. The valve being closed while the other piston compels it to move.

33 Cross-int. 52. Please explain how it is possible, by any construction of Exhibit 6, so far as concerns the width of the slots and the diameter of the wrist pin, to compel any of the pistons to move against the water in the cylinder while the exhaust is closed.

Ans. The valve being opened upon one side, when the piston reaches the end of the stroke it closes and opens upon the other; during the time that that is closed the piston must stand still. If the wrist-pin fills the slot, there is but a very little time that the piston has to stand still. If this time does not correspond with the time that the valve is closed, there will necessarily be a strain.

Cross-int. 53. In Exhibit 6 the speed of the valve is three times as great as in Exhibit 5, the piston speed being the same in each, is it not?

Ans. It is. Under the same conditions; otherwise, it would be.

Cross-int. 54. When the crank is within a sixteenth of an inch of its dead centre in Exhibit 6, how much motion of the other piston would be required in Exhibit 6 to throw the crank over its dead centre and open its exhaust port in Exhibit 6, and how much more motion would be required under the same circumstances to do the same thing in Exhibit 5? Would it not be three times as much motion of the piston in Exhibit 5 as in Exhibit 6?

Ans. It depends on the diameter of the valve somewhat. The movement in Exhibit 6 is faster than in Exhibit 5. With the same diameter of valve it would be three times as fast; but the valve in Exhibit 5 is larger than in Exhibit 6, therefore there would not be so much difference. If the valve in Exhibit 5 was three times as large as the valve in Exhibit 6, the piston movement would be the same to open and close the port.

Cross-int. 55. What part of the stroke of the piston is necessary to open the exhaust in Exhibit 6, and what part in Exhibit 5? I mean to open the exhaust far enough to prevent starting the piston against the water in the cylinder.

Ans. It depends on how closely the valve is fitted up. A very little lap is sufficient if you have it on all the ports, but in practical work there is apt to be a little variation between the ports in the valve seat; it is therefore desirable to give considerable movement to the

34 valve, and the different ports in the valve while the piston is allowed to remain still, to ensure it against imperfection in workmanship and wear of its parts in use, and strain caused by one piston being clogged, so as to work hard, with dirty water or other cause.

Adjourned.

NOVEMBER 21, 1876.

Cross-int. 56. (Question repeated.)

Ans. I could not tell definitely without taking the exhibits apart and

making a plan of each meter. In Exhibit 6 Mr. Desper in making his meter has given nearly half an inch movement in one piston, while the other can remain still. In Exhibit 5 there is about one inch.

Cross-int. 57. What is the length of stroke of the piston in Exhibit 5?

Ans. It is about two and one-half inches.

Cross-int. 58. What in Exhibit 6?

Ans. It is about two inches.

Cross-int. 59. While the piston is moving one inch, or two-fifths of its stroke, in Exhibit 5, the axis of the wrist-pin moves the same distance substantially; and any point upon the circumference of the valve moves less than one-third of that distance, a point in the upper part of the port moving farther than a point in the lower part of the port, but the greatest motion in any part of the port being always less than one-third of an inch; isn't this so?

Ans. Yes, I believe that is so.

Cross-int. 60. In Exhibit 6, while the piston is moving half an inch, or one-fourth of its stroke, any point in the ports moves that same distance, substantially, does it not?

Ans. No, sir; the radius of the crank is greater than the radius of the valve, therefore the valve-ports move less than the crank.

Cross-int. 61. In Exhibit 5, when the wrist-pin of one of the cranks is as far over as its slot will carry it, will the wrist-pin of the other crank be pressed upon by one side of its slot, or will there be a space between this wrist-pin and one side of its slot at this time?

Ans. There will be no space, one piston reinforces the other
35 while it is in motion; still it is not fatal to the working of the meter if it does not.

Cross-int. 62. In your original patent you lay great stress upon the peculiar slot with concavities to the right and left of the centre. In the best construction of your meter, should not the slot be of a width throughout equal to the diameter of the crank-pin or the friction-roll on the crank-pin, where a friction roll is used, except at points at the right and left of the centre, where there should be concavities to allow the crank-pin to pass the dead centre; and will not the moving slot take hold of its crank-pin sooner, and thus carry the other crank-pin past its dead centre if the slots be of a width throughout, except at these concavities, as small as possible to prevent the crank-pin from binding?

Ans. It is not desirable that the crank-pin or roll upon crank-pin should fill the slot at any place, but should be wide enough to give a little play. A curve in the walls of the slot, as shown in the drawing, will improve the running of it; the form of this curve may be varied, and in fact the whole slot may be varied by varying the ports in the valve to correspond with it.

Cross-int. 63. Of course there must be a little play of the wrist-pin in the slot, as otherwise it would bind; but is it not nevertheless clear that, in the best construction of your meter, the slot should be as narrow as possible throughout its width, except where these concavities are? Doesn't the second slot take hold of its wrist-pin and move the other wrist-pin over its dead centre sooner when the slot is well fitted to the wrist-pin or its friction roller than when the slot is wider than the diameter of the wrist-pin? And can you not easily conceive of slots in your meter whose width was so much in excess of the diameter of the wrist-pin that the meter would be locked at every stroke?

Ans. To the first question I should answer that it is not desirable that the slots should be as narrow as possible. The time that the slot takes

hold of the wrist-pin is determined by the opening of the valve to force it forward, and the slot and the valve should be so formed that it will take hold of it at the proper time, not too soon nor too late. To the last question I state, I can.

36 Direct examination resumed:

Int. 64. Look at Exhibit 6, and say whether or not the slot in the piston or connecting-rod is of greater or less width than the diameter of the crank-pin.

(Objected to as already answered in the direct examination.)

Ans. It is about twice the width.

Int. 65. In the operation of the meter, Exhibit 6, does the crank continue to move after the piston stops by coming in contact with the stop at the end of the cylinder?

Ans. It does.

Int. 66. Does the piston so stopped remain stationary while the crank pin moves far enough to change the ports?

Ans. It does.

Int. 67. Suppose that the crank-pin filled the slot or was of diameter equal to the width of the slot, would the piston last referred to remain stationary while the crank moved far enough to change the ports?

Ans. The piston must of necessity stand still while the valve is closed, because the water in the cylinder holds it; if the other piston forces against the crank-pin it would be held by the other slot, it would therefore be locked; this might not happen if the ports were all perfectly fitted up and no extra strain brought upon it, but in practical use it would soon stop or break up.

Int. 68. In your opinion, would the meter, Exhibit 6, be practically operative if the crank-pin was of a diameter equal to the width of the slot in the piston rods and there were no stops at the end of the cylinder?

Ans. It would not; I do not think it would work.

Int. 69. In your cross-examination you were asked some questions respecting the number of teeth in the gearing of the valve and the pinion on the crank shaft. Is the number of teeth dependent on the arrangement and construction of the ports?

Ans. The proportion betwixt the two gears is dependent upon the construction of the ports, but not the number of teeth.

Int. 70. Is or is not the arrangement of teeth in gearing and the relative proportion between them a common matter of mechanical

37 skill or something regarding which a skilled mechanic would require no special instruction?

(Objected to as leading, also as immaterial.)

Ans. When a common mechanic has been instructed what relative speed it is desirable to produce, he ought to be able to construct the gearing properly to produce the result.

Int. 71. Would you consider a man who could not construct the gearing to produce the required result to be a skilled mechanic?

Ans. I should not.

BENAIAH FITTS.

Attest: JOHN G. STETSON, *Examiner.*

Deposition of Hervey Waters.

BOSTON, *Nov.* 21, 1876.

Direct examination by ANDREW MCCALLUM, Esq., of counsel for complainants.

Int. 1. Please state your name, age, residence, and occupation.

Ans. Hervey Waters; seventy-two; Boston, Mass.; machinist; accustomed to testify as expert in patent causes.

Int. 2. Have you examined reissues letters patent, No. 5806, dated March 24, 1874, granted to Ball and Fitts, assignors to the Union Water Meter Company, for "improvements in liquid meters," the same being complainants' Exhibit 4 in this case, and do you understand the invention described and specified in the schedule annexed to said letters patent?

Ans. I have examined the reissued patent inquired of, and I believe I understand what is described in it.

Int. 3. Please examine the meter, complainants' Exhibit 5, and say whether or not said meter is constructed in accordance with the description contained in the specification of said reissued letters patent, No. 5806.

Ans. I have examined Exhibit 5 and find it to agree with the contrivance described in the patent.

Int. 4. Have you examined the meter, complainants' Exhibit 6, and do you understand its construction and mode of operation?

Ans. Yes, to both branches of the question.

38 Int. 5. Do you find in this meter, Exhibit 6, any combination or arrangement of parts the same, or substantially the same, as those described and specified in said reissued patent, complainants' Exhibit 4? And if so, describe those parts, their function and method of operation.

Ans. Yes, I do. In the second clause of the claim of the patent I find it refers to the combination in a liquid meter of a rotary valve represented at *g* in the patent, provided with suitable ports or openings through which the liquid to be measured can be supplied to the meter and discharged therefrom; and it also refers to the cylinders *b* and *b'*, for the reception and measurement of the liquid; and two double-acting pistons, *c* and *c'*, each carrying a rod, *d*, and each of said rods provided with a single cam-slot, *e*, arranged as described in the patent, through which and the crank-shaft *i* rotary motion is imparted to the valve in the manner and for the purposes substantially as set forth in the patent. All these parts I find in the model, complainants' Exhibit 6, combined, arranged, and operating substantially in the same manner and for the same purposes as described in the reissue and referred to in the second claim thereof. There are some specific differences between the machine, Exhibit 6, and the machine described in the patent, in the parts referred to in the second claim, as stated; but they are only formal, and not substantial, when considering the parts referred to in the claim in the light of the state of the art, as I understand it, at the date of the invention, upon which this reissue is founded.

In the machine described in the patent, the cylinders are arranged paralled to each other, consequently the piston rods work parallel to each other, each working on to a crank permanently fastened to a common shaft, so that one cannot move without moving the other; but the cranks are set at right angles upon that shaft, so that when one crank upon the shaft is operated by one piston-rod directly at right angles to

the radius of the crank, the other crank is working parallel to the slot in the other piston-rod. This is an important arrangement in the construction of the machine. In the machine Exhibit 6, the same thing is accomplished in the operation of the machine, by the use of a single crank, the cylinders being arranged at right angles to each other, so that, when one piston-rod is working at right angles to the radius of the crank, that same crank is working parallel to the slot in the other piston-rod, just the same for all practical purposes as is done in the machine described in the complainants' reissued patent, upon which this suit is brought; for in both machines the crank is made to work a rotary valve through the rotation of a crank-shaft, opening and closing the receiving and discharging ports at the same relative time and for the same purposes in the machine, Exhibit 6, as in the machine described in the patent.

Moreover, in the machine described in the patent, the crank-shaft is geared to the valve so that the valve has a less number of revolutions than the crank-shaft, while in the machine, Exhibit 6, there are no such gears, the valve turning with the crank-shaft and making the same number of revolutions; but this difference in Exhibit 6 does not take it out of the contrivance described in the patent. It is true that in consequence of this difference the valve in the two cases must be somewhat different, but only so far different as is well understood of valves for a similar purpose.

Furthermore, there is in the piston-rod to which I have referred some specific difference between the machine described in the patent and the machine, Exhibit 6. In the patent I find these words:

"Our improvement also consists in modifying the form of the widened slot in the piston-rods by providing it on either side, at or near its middle, with a curved depression or cavity, that the following results or operations may be obtained, to wit: First, that each piston may be stopped a little before its valve-ports quite close, and yet allow its crank and crank-pin to be turned over past their dead centre without acting on or being acted on by its own piston by the action of the adjoining piston, and so that the latter, in thus turning the crank, may also move the valve over and open its ports to the other side of the piston just stopped, and that before the crank-pin of the latter piston has reached the point at which, under the action of the other piston, it would compel its own piston to move, thereby preventing the one piston from compelling the other to move while its valve-ports are closed. Secondly, that the piston just stopped, when moving on its return stroke, may sooner reinforce the adjoining piston in its action on the crank-shaft, that the motion of the valve and piston may be more uniform and even, the reinforcement coming at the time most required, that is to say, at the point at which the crank of the then actuating piston nears its dead centre, and consequently at the point in which the cam-slot exerts the least power on it."

Now in the machine, Exhibit 6, this modified form of the widened slot in the piston-rods is not found, nor is it very essential to the operation of the machine; it does not change its mode of operation, except in degree; it in considerable degree makes the machine work smoother and easier, and allows the slot to be less widened otherwheres than might be necessary without. But I do not understand this modified form of slot to be referred in this second clause of claim.

Going now to the fourth clause of the claim, I understand that does not refer to this modified form of slot, but I understand it to refer to

all the parts referred to in the second claim, and in addition thereto to the "adjusting-stops *o*."

The adjusting stops *o* above referred to, I find in the machine, Exhibit 6, acting in combination with the other parts of the machine referred to in the claim in the same manner and for the same purpose or purposes as in the machine described in the patent. It is true that in the machine described in the patent, the adjusting stops or screws have a head for a wrench, so that the screws may be turned out or in to adjust the meter to the desired measurement of the liquid in the cylinders, and it is these heads that impinge against the heads of the cylinders to limit the movement of the pistons so as to get the measurement desired, and these heads are left remaining upon the pistons for that purpose, while in the machine, Exhibit 6, screws are made to work through the head of the cylinder, as I understand, which screws are first provided with a head or other device so that they can be adjusted in the head to limit the movement of the pistons and adjust it to the measurement desired, after which adjustment the heads are cut away, but the points of the screw remain in their adjusted position, and against these adjusted points the pistons impinge in the same manner and for the same purpose that they impinge upon the adjusted screw-heads in the complainants' contrivance.

41 Cross-examination by J. E. MAYNADIER, esq., of counsel for defendants.

Cross-int. 6. Do you assume that the meter shown in the complainants' reissue is the first meter which contained two cylinders for the reception and measurement of the liquid, two double-acting pistons, two connecting-rods, each rod connecting one pair of the pistons, two slots, each across one of the connecting-rods at its middle, and a crank-shaft, having two cranks at right angles to each other, the wrist-pin of one crank working in one of the slots and of the other crank in the other slot, and a valve provided with suitable ports or openings through which the liquid is supplied to and discharged from the cylinders?

Ans. No; but I don't take much responsibility for the word "suitable" contained in the question. That valve might have been suitable to some contrivance without being suitable for the contrivance upon which this suit is brought.

Cross-int. 7. Do you regard the patented contrivance as different any otherwise from the one referred to in your last answer than so far as concerns the valve?

Ans. I did not mean to refer to any other contrivance in my last answer than a contrivance which might have been referred to in the question. I don't know that I know what contrivance the question did refer to.

Cross-int. 8. You don't know any other way, do you, by which you can find out what is new in a patented contrivance except by comparing it with what was before known?

Ans. No, not absolutely; but I suppose that I have a right to assume that when a patent is granted for a new invention it is prima facie evidence that the thing is new until the contrary is proved, because patents are legally granted only on what is new.

Cross-int. 9. Do you believe that the thing described in this reissue is new in respect to having four cylinders and two double-acting pistons and a valve to regulate the inflow and outflow of the liquid?

(Objected to.)

42 Ans. Yes; when constructed and arranged to operate substantially in the manner described in the patent.

Cross-int. 10. Does not the value of your opinion that the differences between the meter described in Exhibit 4, and the meter Exhibit 6, are merely formal, depend entirely on the state of the art, in your opinion?

Ans. No; not entirely.

Cross-int. 11. Suppose the meter described in Exhibit 4 were old in every particular except in the arrangement of the cylinders, pistons and piston-rods, parallel to each other, wouldn't it be ridiculous to say that Exhibit 6 embodied any novelty which was embodied in the patented contrivance?

Ans. I don't know, I am sure, nor can I know without some further description of your hypothetical machine.

Cross-int. 12. That point is this: You testify that certain differences are merely formal; is that not a question that depends wholly upon the state of the art? For example, would not a locomotive infringe a patent for a wheelbarrow if that were the first wheel vehicle known?

Ans. In answer to the first branch of the question—no, not entirely upon the state of the art, but largely undoubtedly. In regard to the second question, I can't answer that unless I understand the construction of the hypothetical locomotive; but I believe I do understand the usual construction of a wheelbarrow, and besides I do not understand how there can be a wheelbarrow without a wheel for it to run upon, but a locomotive might be constructed without wheels.

Cross-int. 13. Upon what else does it depend, in your opinion?

Ans. It depends upon its construction and its mode of operation.

Cross-int. 14. Is it not entirely clear to you that you can't form any opinion as to whether the differences between these two contrivances are formal or not, unless you have in mind a certain state of the art?

Ans. No; but it is true that an intelligent opinion can't be arrived at without.

Cross-int. 15. Look at the meter now shown to you, defendants' Exhibit A (defendants here produce in evidence a meter marked
43 defendants' Exhibit A, J. G. S., examiner), and state whether that differs substantially in any way or not from the meter described in the complainants' reissued patent, and also from Exhibit 5.

Ans. Yes, I think it does.

Cross-int. 16. How many of the complainants' meters have you examined, and how many of them had stops on the piston-rods and the case like Exhibit A, and how many of them had the friction roll on the wrist-pin fitting the slots across the piston-rods, as do the friction rolls in Exhibit A?

Ans. As well as I know, I have examined three of the complainants' meters, neither of which were constructed like Exhibit A in the parts inquired of in question.

Cross-int. 17. Do you know how many times the crank-shaft revolves for each revolution of the valve in the meter described in Exhibit 4?

Ans. No; I do not. I think from the specific description three times. I am not sure, as I have not considered that essential and do not now. The model or machine, Exhibit 5, makes three revolutions of the crank-shaft to one of the valve.

Cross-int. 18. Do you know how many ports are in the valve described in Exhibit 4, how many in the valve-seat, and how many teeth there are on the valve, and how many on the crank-shaft?

Ans. No; I don't. I don t remember that there is any statement in

the patent in regard to that, and I don't know but there is. I will read it through to ascertain if you wish.

Cross-int. 19. Do you know whether it makes any difference or not in the operation of the meter, whether the valve revolves once to three revolutions of the crank shaft or more or less than this number?

Ans. Yes; I know if the valve only makes one revolution to one revolution of the crank it requires to be differently constructed to what would be required if it revolved once to three times of the crank, and this, I suppose, is well known to any constructor of these machines. It is a mere matter of construction and not necessarily involving invention.

Cross-int. 20. Suppose the stop *o* at one end of the piston were adjusted as far out as possible, and the stop *o* at the other end of
44 the piston of that pair as far in as possible, and the other two stops had a varying adjustment, would not that prevent the proper action of the meter described in Exhibit 4?

Ans. I don't understand the question; but it is undoubtedly true that if the machine were so constructed and proportioned as not to admit of the desired adjustment it would be an abortion, as far as the stops are concerned, and not the machine described in the patent.

Cross-int. 21. Is it not necessary, for the proper action of the machine described in Exhibit 4, that the distance between the points of contact of the stops *o o* and a line parallel to and half-way between the flat surfaces of the slot, must be equal to a distance between the same line and the points of contact between the other two stops; that is to say, must not the stops be so adjusted in both pistons that the slot shall move just as far and no farther to the right than to the left of the axis of the crank-shaft?

Ans. No; this is not true of the machine described in the complainants' patent as a necessity in the operation of that machine; it is better so undoubtedly, but it is an essential feature in that organization that the adjustment of the stops may not be perfectly as supposed in the question, and yet the machine be capable of running without danger to its construction.

Cross-int. 22. If these stops were so adjusted that the centre of the line of the slot would go say, an eighth of an inch beyond the axis of the crank-shaft when the piston was moved in one direction and stop an eighth of an inch short on the return movement of the piston, would it not destroy the practical operation of the machine?

Ans. It might or it might not; it would depend on the relative size of the diameter of the crank-pin and the breadth of the slot in the piston-rod. If the slot in the piston-rod were five-eighths of an inch wide and the crank-pin a half inch in diameter, then the unequal adjustment supposed in the question would not prevent the operation of the machine, I believe. All that is necessary here is that the piston should not be so stopped that the crank-pin cannot pass lengthways of the slot when the pistons, either of them, are at their extreme outward movement.

Cross int. 23. The proper operation of the machine requires
45 that these stops should be so adjusted that the central line of the slot should always move the same distance to the right as to the left of the axis of the crank-shaft, doesn't it?

Ans. No; and it is in just that that the excellence of the machine consists in a large degree, so far as the widening of the slot is concerned; if the slot were no wider than the diameter of the crank-pins, then the tops would be of no use, because the pistons in that case must always

make a movement equal to the diameter of a circle described by the axis of the crank-pin, and if stops were used they would have to be so adjusted as to work coincident therewith and stop the piston at the same place that the crank would stop it, and therefore such stops would be useless, and might be very mischievous if improperly adjusted.

Adjourned.

NOVEMBER 22, 1876.

Cross-int. 24. Suppose the slots were of the same width throughout, and wide enough to allow the wrist-pin to move over an arc of ninety degrees while the piston remained at rest, would not that make the meter described in Exhibit 4 wholly inoperative?

Ans. I am inclined to think it would not be much of a meter in that case. I am not now prepared to say it would be wholly inoperative, but much would depend upon what point in the revolution of the crank the ninety degrees were taken.

Cross-int. 35. I had supposed, in my question, forty-five degrees below and forty-five degrees above the dead centre. Can you, with this explanation, give a fuller answer to the preceding question?

Ans. Rather fuller, but I am not prepared to answer it fully. Ninety degrees of the circle of the revolution of the crank might take place with a narrower slot at the points defined in the last question than at any other points; but just how wide the slot might be, in proportion to the wrist-pin and the length of crank, and still the meter be a good one, is not within my knowledge. All I know is that, with some considerable play of the wrist-pin in the slot, the machine is better than without that play, and this is because greater inaccuracies of construction
46 are admissible in the machine, and also because of the capability of the machine when thus constructed to allow of an adjustment of the stops, not only so as to procure a more accurate measurement of the liquid, but also so as to admit of supporting the pistons upon the stops at the end of their stroke, thereby relieving the crank-pin from strains which it might and would be subject to if the slot were no wider than the diameter of the crank pin.

Cross-int. 26. The wider this slot, if it be of the same width throughout, the longer it will be before the piston, which stands still while the other piston moves the crank-shaft far enough to carry the wrist-pin of the piston at rest over its dead centre, reinforces on its return stroke the second-named piston, will it not? And this reinforcement is vitally necessary for two reasons: First, because the slot which is moving the wrist-pin (by which the crank-shaft is moved during the time the other wrist-pin is moving through its stationary slot) is moving slower and slower, owing to the fact that its inlet port is growing smaller and smaller; and secondly, because the motion of this slot imparts less and less motion to its wrist-pin as this wrist-pin approaches its dead centre.

Ans. No; I think not. As I understand this contrivance, there is no such physical law entering into its construction, as I understand the question to imply.

Cross-int. 27. Is not the inlet port, which supplies water behind the moving piston, always wide open when its slot and the crank are in line, and when the other slot across the connecting-rod of the pistons at rest is at right angles to the crank?

Ans. Yes; it is or should be.

Cross-int. 28. Does not it grow smaller and smaller as this slot, which is in line with the crank, moves the crank towards its dead centre?

Ans. No, not necessarily and immediately; nor is the port ever

closed which belongs to this individual cylinder whose piston-rod slot has just passed the crank, as the question supposes, but it is closed by the other piston-rod belonging to the other cylinder, as I understand it.

Cross-int. 29. In the question, one crank is in line with one slot, and the other crank is at right angles with its slot, and the question
47 is, Does not the moving slot make the inlet-port smaller and smaller as it moves forward?

Ans. That is just the way I understood it, and I say, No; it does not make its own port smaller and smaller, as I understand it.

Cross-int. 30. Does it not make the area of the inlet smaller and smaller?

Ans. No; not necessarily.

Cross-int. 31. When the inlet port is wide open, that is, its area at the maximum, the crank is vertical; any motion of the crank-shaft on its axis moves the valve on its axis, and any motion of the valve on its axis reduces the inlet area; isn't this clearly so?

Ans. That depends on what you mean by "inlet area"; if you mean simply and only the area of the holes through which the water passes in the valve-seat, then the valve used in the complainants' patent will do what you say, perhaps, but I do not understand that to control the action of this machine, or it to be essential to its operation, that it should do so; but what I mean to say is this, that while the piston is passing the crank-shaft, or while the slot of the piston is passing the crank-shaft, and for considerable distance before and after such passing, the inlet-port might as well or better remain of a uniform size.

Cross int. 33. Do you know what valve is described in Exhibit 4?

Ans. Yes; a rotary valve. I believe I have already said that its specific construction was not described in the patent, and I also said I did not think it need to be, under the state of the art as it existed at the date of this invention.

Cross-int. 34. Is it not clear to you that in the machine described in Exhibit 4, the port is nearly closed when the crank approaches within ten or twelve degrees of its dead centre, wholly closed when the crank is at its dead center, and commences to open before the crank gets, say, ten or twelve degrees beyond its dead centre?

Ans. No; it is clear that the valve belonging to the piston-rod in which the crank is passing its dead centre should be closed at or about the time of such passing of its dead centre; but with the widened
48 slot in the piston-rod, the actual closing may take place before or after such passing, and that fact gives to this machine its excellence over and above what it would have if the slot were of the size of the crank-pin, because if such were the fact the machine would have to be so adjusted as that the closing should take place, not before, but as the crank arrives at such dead point; and as machines of this kind will wear, and by such wearing change their relative adjustments, they are liable to get into that condition where the valve closes before the crank does arrive at this dead point, and as the crank at such closing is driven forward by the other piston-rod forcing the crank past its dead centre over the surface of the slot at an inclination, the machine is liable to break up, or be so strained as to injure its action.

Cross-int. 35. Would you regard Exhibit 6 as substantially the same as the mechanism referred to in the second and fourth claims of Exhibit 4, if the wrist-pin in Exhibit 6 fitted the slots as closely as wrist-pins usually fit slots in machines where a reciprocating slot or slots are used to drive a crank-shaft, and the slots were of the same width throughout?

Ans. No; the claims refer to the machine described in the patent, and the machine, as there described, has the widened slots; but I think that a machine otherwise constructed as that machine is, only having slots of uniform width and such as would fit the crank-pins, would be altogether a new contrivance—I mean a new contrivance taken as a unit—and I think the patentee would have a right to claim it; moreover, I think he does claim it in the second claim of his patent; but that is a question of law upon which I am not qualified to testify. I think such a machine would not infringe the fourth claim of the patent, because that clearly refers to the widened slot.

Cross-int. 36. You misapprehend my question, which was whether Exhibit 6, altered as supposed, would be the same mechanism substantially as that described in the patent and referred to in the second and fourth claims, in your opinion, in view of the state of the art.

Ans. I understand the question just as I did before, and give the same opinion in answer.

Cross-int. 37. Will Exhibit 6, altered as supposed, embody anything described in the patent which you believe to be new?

49 Ans. Yes, it embodies the same combination, construction, and arrangment, except the widened slots, the slots being as narrow as the diameter of the crank-pin, instead of wider.

Cross-int. 38. Do you find anything in Exhibit 6 answering to the crank-shaft, its pinion, the double cranks at right angles to each other, and the gear upon the valve?

Ans. There are no gears in Exhibit 6. All the other things are there substantially as I have stated in my direct examination.

Cross-int 39. Does not the invention and the only invention described, suggested, or substantially indicated in Exhibit 1, consist in the use of a peculiar form of slots in water meters of the class therein described, namely, slots in which the crank-pins fit as usual when the cranks are not about passing their dead centres, but which are cut away on each side, substantially as described in Exhibit 1, for the purpose of allowing a certain movement of the cranks while their slots are at rest? And is not this invention particularly valuable where the valve moves through say only one degree, while the crank-shaft is moving say through three degrees, and of no practical value where the valve moves one degree for every degree moved by the crank?

(The first branch of the question objected to.)

Ans. To the first branch of the question I answer no, decidedly. To the second branch, I say I have not considered that question so as to have a decided opinion, that matter not being in controversy in this case, as I understand, because there are no such curved form of the slot in the defendants' machine.

Cross-int. 40. What is there in Exhibit 1 which leads you to believe that any other widening of the slot is therein described, suggested, or substantially indicated, except the concavities?

(Objected to, the witness not having been asked any questions on Exhibit 1 in his direct examination.)

Ans. The drawing at Fig. 2, where the parallel sides of the slots are a considerable greater distance from each other than the diameter of the crank-pin. That slot is referred to in the patent where it says, "*e* is

50 a slot in the connecting-rods. It will be seen that the sides of this slot are not parallel or straight, the slots being wider in the middle than at the ends." But it will be seen on examination of the drawing that the slot is wider than the crank-pin at the end of the slot also.

Direct examination resumed:

Int. 41. You spoke of defendants' Exhibit A in answer to Int. 16. Does the friction-roll on the wrist-pin fit the slot in the piston-rod throughout the length of the slot?

Ans. No, it does not; it comes near fitting it at the end of the slot, but at the middle of the slot the slot is full an eighth of an inch wider than the diameter of the roll, giving it all the advantages of the widened slot, because it is only in the central portion of the slot that this widening is essential.

HERVEY WATERS.

Attest:

JOHN G. STETSON, *Examiner.*

51 EVIDENCE FOR DEFENDANTS.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States in equity, as amended, before me,

CHARLES F. SLEEPER,
Special Examiner.

Present, Andrew McCallum, esq., of counsel for complainants; James E. Maynadier, esq., of counsel for defendants.

Deposition of Daniel C. Fisher.

BOSTON, *Jan.* 24, 1877.

Direct examination by Mr. JAMES E. MAYNADIER, esq., of counsel for defendants:

Int. 1. State your name, age, residence, and occupation.

Ans. Daniel C. Fisher; twenty-nine; Worcester, Mass.; machinist.

Int. 2. How long have you been a machinist, and what experience, if any, have you had in the manufacture of water meters?

Ans. About eleven years. I was engaged by the Union Water Meter Company as a machinist on water meters. The date of my going to work for them was the 1st of June, 1869. My services were finished with them on the 19th of the same month. I have been more or less connected with the Worthington meter, and I have examined other meters as well.

Int. 3. Please examine carefully the meter now shown you, and state if you know who made that meter. (Complainants' Exhibit 5.)

Ans. I do not know.

Int. 4. Did you make any meters when you were in the employ of the Union Water Meter Company? If so, how many, and how did they compare with Exhibit 5?

Ans. In answer to that question I will state that I put together six one-inch meters and six half-inch meters. The main body of
52 the cylinders of Exhibit 5 is the same as the meters I made. The piston-heads were cast-iron, with a groove turned in and a piece of leather used as packing. Through this piston-head under the rim was a number of small holes to press the packing against the cylinder. The screws used as stops were short-headed screws and washers. The half-inch meters were fitted with a composition head, with a core inside to press together and make it expand. There is no further difference that I can recognize, excepting the slot in the piston-rod was intended to fit the whirl on the wrist-pin of the crank, at both ends of the slot.

Int. 5. How many meters of this kind (Exhibit 5) have you examined since June, 1869, as near as you can now state?

Ans. Not any. I have seen of course the Ball and Fitts meters, but not this Exhibit 5.

Int. 6. How did these Ball and Fitts meters which you have seen differ from Exhibit 5?

Ans. They were similar in all respects, with the exception of the filling between the composition lining and the outside shell. This slot in the connecting-rod (Exhibit 5) is wider than any I have ever seen. There is no further difference that I recognize.

Int. 7. When you speak of the width of the slot in Exhibit 5, did you observe that it was much worn? If not, please examine it as to this; and also examine the whirls on the wrist-pins, and state, so far as you are able, whether they are worn away or not, giving your reasons.

(Objected to as leading.)

Ans. The slot in the connecting-rod appears to be worn, and the whirls on the wrist-pins are worn away by rust and contact with the slot in the connecting rod.

Int. 8. What were these whirls made of in the meters you made in '69, and how were they formed, that is, by casting, turning, or otherwise?

Ans. I am not prepared to state whether they were steel or wrought-iron. They were formed by drilling a hole in the centre and turning them up in a lathe.

Int. 9. What kind of stops were used in those meters you made
53 in June, '69? And state how the stops were used, and for what purpose.

Ans. The stops consisted of a screw on the end of the piston-rod and one or more washers as the occasion required. They were used to adjust the position of the piston at the end of each stroke.

Int. 10. What was the purpose of adjusting the position of the piston at the end of each stroke?

Ans. The piston was adjusted at the end of each stroke to allow the whirl on the end of the wrist-pin to pass freely through the slot in the piston-rod without binding.

Int. 11. When did you first know of washers being used to vary the stroke of the piston in a water-meter?

Ans. In the beginning of my engagement with the Union Water Meter Company.

Int. 12. How was the stroke of the pistons adjusted, if at all, in the Worthington meters, and what was the purpose of this adjustment?

Ans. I don't recollect.

Int. 13. In adjusting the stroke of the pistons by the washers, in the Ball and Fitts meter, how is the quantity of water discharged affected, and what, if anything, has that to do with the stroke of the piston? Please explain this matter.

Ans. The adjustment of the stroke discharges more or less water according to the number of washers used.

Int. 14. Suppose the stroke were adjusted by the washers so as to make the middle line of the slot move just as far on one side of the axis of the crank-shaft as it did on the other side of that axis, and suppose that when so adjusted the meter discharged too much or too little water; would you change the stops in that case; and, if not, why not?

Ans. I shouldn't change the stops, because when the stops are rightly adjusted the meter is working in its most perfect condition.

Int. 15. Has the quantity of water discharged anything to do with the adjustment of these stops; if not, what does control the thickness of the washers used at each end of the piston-rod?

Ans. The quantity of water is affected by the adjustment of the
54 stops, but the piston must hold a certain relation to the crank in order to allow the crank to pass by the centre.

Int. 16. Suppose one of these Ball and Fitts meters, with the stroke of the piston so adjusted by the stops that the quantity of water discharged is just right, but that the stops allowed one piston to move, say an eighth of an inch farther from the axis of the crank-shaft than the other piston could move; what would you do in that case about the stops?

Ans. If the cranks worked perfectly free, I should let them alone.

Int. 17. Would they work free in the Ball and Fitts meter, properly constructed, if one piston was not arrested by its stop until it could move an eighth of an inch farther from the crank-shaft than the other one could?

Ans. I think they would.

Int. 18. Suppose the stops adjusted all right to make the cranks work freely, and the quantity of water discharged is wrong, that is, that the register shows more or less than the actual quantity of water discharged, what is the proper thing to be done?

Ans. If the meter was in proper working condition and all right, I should change the registering apparatus to suit the quantity of water.

Int. 19. Please examine the patent now shown you, reissue 5806, and state whether a mechanic skilled in the art of making water meters could manufacture the meter therein referred to.

(Objected to, witness not having qualified as an expert, and the question calling for an opinion and not for his own capability to construct a meter from the description therein given. Question withdrawn.)

Int. 20. Please examine the patent now shown you, reissue 5806, and state whether you could manufacture the meter therein referred to. I mean, of course, without a model of it, and without seeing a working meter.

Ans. I don't think that I could, sir.

Int. 21. Look at sheet 2 of the drawings, Fig. 1, and state if you can understand how the crank-shaft *i* and the crank *m* are arranged in relation to the piston-rod *d*, referring to the description, if that
55 will aid you. Before answering, state what experience you have had in the use of mechanical drawings, accompanied by descriptions; and also whether your experience as a machinist qualifies you, or not, to understand such drawings.

Ans. I had some three months' experience in the Putnam Machine Company's works at Fitchburg, Mass., on air compressors and the Burleigh rock drill, and descriptions were given and the drawings. We worked from them. I worked from drawings on other machinery in different shops. I also worked from drawings in the Boston Machine Company's works. I think my experience as a machinist does qualify me to understand such drawings. I should not understand from the drawing, Fig. 1, the exact position of the crank in its relation to the piston-rod. There are whole lines shown outside of the piston-rod in this drawing of the crank. According to all drawings that I have worked from, they should be dotted lines representing the other side of

the crank. I mean to state that the crank should be shown in dotted lines as being on the opposite side of the piston-rod.

Int. 22. Look at all the drawings carefully, using the description so far as it will aid you, and state whether you can determine in any way the form of the slot in which the wrist-pin *n* works; and, if so, what kind of a slot is that, especially as to having open or closed ends? Of course, in all these answers, you will get rid as far as you can of that part of your knowledge of the Ball and Fitts meter derived from working on them and seeing them.

Ans. There seems to be a variety of sizes of slots represented in the drawings. Fig. 1 is the only one that shows any concavity in the slot. Fig. 2 has two sizes of slots; one slot nearly fits the whirl on the wrist-pin, which as I understand is a correct representation of the slot, and to the best of my knowledge that was the kind of slot used with the concavities on each side of the slot in the centre of the piston-rod. It has open ends.

Int. 23. Point out what makes you think that the slot shown in the drawings has open ends.

Ans. There are no dotted lines over the whirls in Fig. 2 to show that they were closed.

Int. 24. How can you reconcile the slots shown in Figs. 1 and 4 with the slot shown in Fig. 2?

56 Ans. The specification calls for a rotating shaft with a crank-pin. The pin on the end of the crank is connected to the crank-shaft. This crank-pin can revolve or turn over in this slot, which the slots represented in Figs. 1 and 4 would not permit unless open like those shown in Fig. 2.

(Noon recess.)

Int. 25. Can you find any description in the specification or the drawings which will aid a competent mechanic in making a rotary valve suitable for the meter described in the patent, or in putting such a valve in the meter and actuating it correctly?

Ans. I can't find any description of the form of valve or the position of the ports in the valve that would, in my estimation, enable a man to construct a valve that would operate this meter.

Int. 26. Did you have any knowledge of any valve before June, 1869, which would operate this meter? If so, what?

Ans. I did not.

Int. 27. How does the valve in Exhibit 5 resemble or differ from the valve described in the Ball and Fitts patent, No. 92691, dated July 20, 1869, a copy of which is now shown you? (Now put in evidence and marked Exhibit Ball and Fitts 1869 patent, C. F. S., special examiner. The copy now put in not being certified, it is hereby agreed that it shall be certified before being put into court.)

Ans. I should say the valve represented here in this patent was similar to the one in Exhibit 5.

Int. 28. Do you see any substantial difference between the two valves?

Ans. I do not.

Int. 29. Now, suppose you knew all about the valve and the meter described in the 1869 patent, and state whether you can find any information in the reissue 5806 which would enable you to introduce that valve into the meter described in the reissue patent 5806 and actuate it properly.

Ans. I don't think that I could.

Int. 30. Please state why you could not.

Ans. There is no information given in the specification which any man or I could take for the location of the bearing of this crank
57 in connection with the valve. The crank-shaft represented in this Fig. 2 of the reissue has the appearance of lying loose in the centre of the cylinder without bearings, no bearings being indicated.

Int. 31. Please compare Figs. 1 and 2 of the original Ball and Fitts patent, No. 109372 (Exhibit 1), with the corresponding figures in the reissue, and state which more correctly show the Ball and Fitts meter of the kind shown in Exhibit 5.

Ans. In my opinion, the original drawings are the most correct.

Int. 32. Can you discover any error in the original drawing?

Ans. I see no evidence of a bearing for the crank-shaft in the original drawings any more than there is in the reissue. That's the only error that I am able to see in the drawings.

Int. 33. In Fig. 1 of the original the piston rod near the bottom of the sheet is shown with its slot actuating the crank and with the whirl *n* fitting the slot. How is this with the corresponding drawing of the reissue marked Fig. 2 on Sheet 1, and which is the more correct, so far as you know the construction of the meters?

Ans. In the drawing of the original the whirl has the appearance of being a fit, but in the drawing of the reissue there is a considerable play. My impressions are that the original drawings are the correct view of the meter.

Int. 34. How should the diameter of the whirl on the wrist-pin compare with the width of the slot, except where it is cut away to form the concavities *v* to get the best operation, when the meter is constructed as shown in Exhibit 5?

Ans. My impressions are that they should be loose enough to pass through the slots without friction.

Int. 35. In the reissue patent it is stated, "Our invention consists, first, in combining with a rotary valve and a crank-shaft to operate it a double-acting piston," etc. "Our invention also consists in combining with a rotary valve and a crank-shaft to operate it two double-acting pistons," etc. "Our invention further consists in combining with a rotary valve and crank-shaft to operate it, and with a double-acting piston, adjusting stops so arranged," etc. Please examine Exhibit 6, and state whether you find in that any crank-shaft or its equivalent.

Ans. I do not.

58 Int. 36. A good deal is said in the reissue patent about making the slot of a width somewhat greater than the diameter of the wrist-pin. Please examine the meter shown in the Ericsson patent, No. 7869, dated Jan. 1, 1851, a copy of which is now shown you (here put in evidence and marked Exhibit Ericsson Patent, C. F. S., special examiner), and state what difference, if any, there is between the slot and wrist-pin therein described, so far as concerns the width of the slot in its relation to the diameter of the wrist-pin and the widened slot and wrist-pin described in the reissue 5806, and shown in Fig. 2, Sheet 1; and also what difference there is, if any, between the operation of these parts in the two contrivances.

Ans. The widened slot in the Ericsson patent seems to be very much larger or wider than the crank-pin. It evidently passes over a greater amount of surface, while one piston is at a stand-still, than that represented in the reissue of Ball and Fitts. I fail to see any difference in the operation of the cranks and the slots with the pin in the slots.

Cross-examination by ANDREW MCCALLUM, esq., of counsel for complainants:

Cross-int. 37. What experience, if any, did you have in the construction and operation of water meters before you went into the employment of the Union Water Meter Company?

Ans. My experience was chiefly confined to the machines manufactured by the Boston Machine Company in South Boston, and was not of any great extent.

Cross-int. 38. What meters did the Boston Machine Company make when you were in their employment?

Ans. I can't state positively the different kinds of meters that they made, but I am now under the impression that they were furnishing several of different manufacture.

Cross-int. 39. How long were you in the employment of this company, and what were your duties while so employed? I mean the Boston Machine Company.

Ans. I was in their employ in the vicinity of three months; was a common workman in the shop. I am unable to state how much I worked on the meters; I worked some on them.

59 Cross-int. 40. When was that, and had you ever worked on meters before that?

Ans. The fall of 1868, and fore part of the winter of the succeeding year. I had not worked on meters before that.

Cross-int. 41. Have you had any practical experience in the construction of meters since you were employed by the Union Water Meter Company? If so, please state what it was.

Ans. I have not.

Cross-int. 42. While you were in the employment of the Union Water Meter Company, did you construct the meters you referred to in your direct examination, or merely put them together after the parts were made?

Ans. I put them together.

Cross-int. 43. Did you have anything to do with the testing of them and adjusting the stroke of the pistons?

Ans. I had nothing to do with the final adjustment; I put them together and let the water on to them before the final adjustment took place.

Cross-int. 44. In those meters which you referred to, did the piston-rods have the same form of slot as shown in Exhibit 5?

Ans. I believe they did, with the exception of the wear; they had those concavities on both sides which form the widened place in the centre of the slot.

Cross-int. 45. Please look at Exhibit 5 again and say what portion of the walls of the slot show signs of wear.

Ans. The extremity of the slots on both sides.

Cross-int. 46. Does the central or widened portion of the walls of the slot, which you call the concavities, show similar signs of wear?

Ans. I don't discover any.

Cross-int. 47. Are the adjusting stops of Exhibit 5 the same or similar to those in the meters you put together?

Ans. They are similar to those that I put together.

Cross-int. 48. What is the function of these stops, or why do they get the name "stop"?

Ans. They were put in for the purpose of stopping the piston at any desired point by coming in contact with the cylinder head.

60 Cross-int. 49. When you speak of a screw on the end of the piston-rod, in your direct examination, in connection with one or more washers, do you mean to be understood as referring to a screw thread cut on the end of the piston-rod or to a detachable stop device which is screwed into the end of the piston-rod, the washers being placed between its inner shoulders and the piston, like the device shown in Exhibit 5?

Ans. I mean to be understood that the stop was exactly like that in Exhibit 5, and for the same purpose.

Cross-int. 50. What is the purpose of this detachable and adjustable stop device and the washers, as you understand it?

Ans. I understand that the detachable stop device was placed there for the purpose of stopping the piston with the slot, in its proper position for the wrist-pin to pass through the slot without friction.

Cross-int. 51. Could this result not be accomplished as well by having the ends of the piston-rod project the proper distance beyond the pistons?

Ans. I believe it could.

Cross-int. 52. Then what is the object of having the stops adjustable, and interposing the washers between them and the pistons?

Ans. In my opinion, they were put there to compensate for the difference in the thickness of the packing that might be placed between the cylinder and the cylinder head.

Cross-int. 53. Do you think that's the object of these washers in this Exhibit 5?

Ans. That is my impression.

Cross-int. 54. Suppose a meter in which this packing is dispensed with: in your opinion, would that also obviate the necessity for the use of the washers?

Ans. Not necessarily.

Cross-int. 55. Why not?

Ans. Because they have yet to adjust the piston to its proper position in relation to the crank.

Cross-int. 56. Please explain what you mean by the piston and piston-rods. Define what constitutes a piston, as you understand it.

61 Ans. I understand the piston to consist of a head that will fit the inside of a cylinder, connected with a rod passing through this piston-head.

Cross-int. 57. How many washers are on the piston now handed you, being one of the double pistons of Exhibit 5, the connecting-rod of which is marked with the letter *d*?

Ans. Three; one at one end and two at the other.

Cross-int. 58. What effect would the removal of one of the washers on the end that has two, and the adjustment of the screw stop to correspond therewith, have upon the operation of the meter, in your opinion?

Ans. In my opinion, if the meter was properly adjusted with these two washers on that end, the removal of one of those washers would throw it out of harmony with the crank and wrist-pin.

Cross-int. 59. Would the removal of the additional washer not have the effect of lengthening the stroke of the piston?

Ans. I believe it would; if you moved it the thickness of a sheet of paper it would lengthen the stroke.

Cross-int. 60. What would be the effect of lengthening the stroke on the quantity of water measured by the cylinder?

Ans. A larger quantity of water would pass through the cylinder.
Adjourned.

BOSTON, *Jan.* 25, 1876.

Cross-int. 61. Please look again at the double piston and rod you have been testifying about, and say what is the width or thickness of the outside washer on the end which has the two.

Ans. About the thirty-second of an inch, as near as I could judge, it would measure. I find it to be a sixteenth by measurement.

Cross-int. 62. Would the removal of that washer interfere with the free movement of the crank-pin and what you call a whirl within the walls of the slot of the connecting or piston rod?

Ans. I don't think it would.

Cross-int. 63. What is the length of stroke of that piston?

Ans. Two inches and a half.

62 Cross-int. 64. Suppose you remove this one-sixteenth inch washer, what difference in percentage would that make in the length of the stroke and the resulting quantity of water?

Ans. It is a percentage of one-sixteenth to forty.

Cross-int. 65. If you so alter the washers as to increase the length of the stroke one one-hundredth part of its length on both sides, or one per cent., will not that increase the discharge one per cent.?

Ans. Yes, sir.

Cross-int. 66. Such an adjustment would be less than the removal of a washer one-sixteenth of an inch thick, would it not?

(Objected to as a question of mathematics.)

A. Yes, sir.

Cross-int. 67. Could you effect such an adjustment by the removal of one washer and the substitution of a thinner one, or by filing down one washer to the required thickness?

Ans. Yes, sir.

Cross-int. 68. Could you, by means of these adjustable stops and washers, that is, by adding washers or substituting thicker ones, decrease the stroke of the piston and consequent measurement of the quantity of water?

Ans. Yes, sir.

Cross-int. 69. Suppose the stops were not adjustable, but to consist of prolongations of the piston-rod beyond the piston-head, or of fixed stops on the ends of the cylinder or cylinder heads: could you effect the same adjustment of the length of the stroke and consequent discharge of water?

Ans. Yes, sir.

Cross int. 70. How? Please explain how you would do it.

Ans. By adding to or taking from the ends of the stops.

Cross-int. 71. Do you mean by filing off the ends or adding pieces to the ends?

Ans. Yes, sir.

Cross-int. 72. As a practical machinist, do you consider that as good a way as having the stops adjustable, as in this Ball and Fitts patent?

Ans. No, sir.

63 Cross-int. 73. You have stated in your direct examination in answer to int. 18, that you should change the registering apparatus to suit the quantity of water, if the register showed more or less than the actual quantity of water discharged, while in other respects the meter was working properly. Please examine the train of gearing now handed you, the same being the registering device of Exhibit 5, and

say what proportion the teeth of the pinion has to the teeth of the wheel in which it gears.

Ans. The relation of ten to fifty-four.

Cross-int. 74. How would you alter this gearing to effect the adjustment you referred to, supposing the length of stroke of the pistons not to be in proper relation with the gearing as now fixed?

Ans. By changing the number of teeth in the small gear to a greater or less number, as the occasion required.

Cross-int. 75. Suppose you were to remove one of the teeth of the pinion, or small gear, what difference or percentage in the quantity of water discharged would that adjustment be equal to?

Ans. I am unable to determine.

Cross-int. 76. The relation being ten to fifty-four, and you change that relation to nine to fifty-four, what difference in percentage is that?

Ans. The difference of five and four-tenths and a sixth.

Cross-int. 77. Suppose you add a tooth to that pinion, what would be the difference—making it eleven to fifty-four instead of ten to fifty-four?

Ans. The difference of five and four-tenths and four and ten-elevenths.

Cross-int. 78. Is not the difference in either case one-tenth?

Ans. I don't think it is.

Cross-int. 79. Suppose you were testing a meter, and found it measured one per cent. too little, though in other respects it worked perfectly: could you make it register properly by adding a tooth to the pinion, or, vice versa, supposing it measured one per cent. too much, could you make it register properly by removing a tooth from the pinion?

Ans. In my opinion, you could not.

Cross-int. 80. In such a case, what would be the proper course to pursue, supposing the meter to have adjustable stops?

Ans. I should change the teeth in the larger gear more or less,
64 as the occasion required, in combination with a similar change in the small gear.

Cross-int. 81. Suppose you took out a tooth from the large gear, what difference would that make, what percentage, the ratio of proportion being, as before stated, ten to fifty-four?

Ans. It would be five and three-tenths, whereas before it was five and four-tenths.

Cross-int. 82. Would such a change as that make the meter register one per cent. too much, it being before correct, or what difference would it make?

Ans. I think it would make more than one per cent. and less than two.

Cross-int. 83. Now, suppose that the meter measured one per cent. less than the standard, could you by the removal of one of the teeth of the large wheel make it register correctly?

Ans. No, sir.

Cross-int. 84. Then, in such case, you being unable to make it register correctly by alteration of the number of teeth of either gear wheel, how would you proceed to adjust the meter to make it register correctly, supposing it was a meter such as Exhibit 5, having adjustable stops? Please to answer the question as a practical mechanic what would be the shortest and quickest way of making the adjustment.

(Objected to because based upon the erroneous assumption that meters like Exhibit 5 can be made to measure water within one or two per cent. of the exact amount.)

Ans. If I found myself unable to arrive at the desired result by a

change of gears, and I could change my pistons by means of the adjustable stops, without producing unnecessary friction upon the crank-shaft, I should do it by that means; that is, by the adjustable stops.

Cross-int. 85. In answer to int. 9 you say that the stops are used to adjust the position of the piston at the end of each stroke. Please explain more fully what you mean by this. Do you mean to be understood as saying that the stops adjust the position of the pistons each time they reach the end of the stroke, or how?

Ans. I understand that, there being no positive connection
65 between the crank-shaft and the piston, that each piston requires an adjusting stop at the end of each stroke to place it in proper relation with the wrist-pin on the crank.

Cross-int. 86. Please look at the paper I now hand you, the same being a copy of the specification of the Ball and Fitts original patent of 1870, and say whether or not you could construct a meter from that description (such as Exhibit 5) without of course having any previous knowledge of how that meter is constructed.

(Objected to as immaterial.)

Ans. I do not think that I could.

Cross-int. 87. Please examine it with reference to the sheet of drawings which accompanies that patent, and state if you could, with the aid of those drawings, construct the meter.

Ans. I don't think I could.

Cross-int. 88. Please compare the drawing of the original patent, No. 109,372, particularly the figure at the bottom of the sheet, with Exhibit 5, and state whether that drawing is a fair representation of the meter now before you, except that in the drawing a portion of the cylinder nearest to you is shown cut away.

Ans. I don't think the drawings are a correct representation of the interior part of this meter.

Cross-int. 89. Do you find in the model (Exhibit 5) a bracket or frame which forms the journal for the crank-shaft, its sides having arms which rest in grooves or slots formed in the casing or shell?

(Objected to for the reason that there is nothing whatever said in the specification about any such bracket or frame, or arms, or journal for the crank-shaft, or grooves or slots.

Counsel for complainants calls attention to the fact that the question is not directed as to anything contained in the specification of the patent referred to, but to Exhibit 5, a meter in evidence in this case, and he objects to this indirect manner of counselling the witness.)

Ans. Yes, sir.

Cross-int. 90. Do you find corresponding parts shown in the drawing before referred to?

Ans. I find no evidences of a journal in this drawing.

Cross-int. 91. Do you find the bracket referred to?

Ans. I find lines which partially show such a bracket.

66 Cross-int. 92. Will you please mark on the drawing of complainants' Exhibit 1 any of the parts which you find to correspond with the parts of Exhibit 5, using designating letters. I refer particularly to the interior of the meter as seen through that opening.

Ans. I have marked the parts that I recognize, A being the wrist-pins, B the cranks, C the small bevel gear, D the large bevel gear, E the projections on the bracket, G the frame of bracket, and H the valve.

(Noon recess.)

Cross-int. 93. Does not the framing which you have designated by the letter G constitute the journal-bearing for the crank-shaft?

(Objected to because the question is ambiguous, and may refer to the meter in Exhibit 5 or to the drawing of the original patent.

Counsel for complainants says it refers to both, the same part having been identified in each by the witness.)

Ans. It does not.

Cross-int. 94. What is its office?

Ans. I understand this framework marked G to constitute a support to keep in position a journal. No journal is indicated on this drawing.

Cross-int. 95. Is there any journal in Exhibit 5 shown as a part of the frame which you have referred to as the frame G in your previous answers?

Ans. Yes, sir.

Cross-int. 96. Is not the shaft inclosed within and hidden by that portion of the frame G which constitutes the journal in Exhibit 5?

Ans. Yes, sir.

Cross-int. 97. In your direct examination I think you said the drawing of the original patent was correct, except that it did not show the journal, and that the drawings of the reissue were incorrect. Please compare said drawings again, the same being the drawings on Sheet 1 of the reissue, and the only drawings of the original, and state whether there is any material difference between them, except that in the one (the upper drawing of the reissue) the position of the crank is shown in full lines, while in the corresponding drawing of the original it is
67 shown in dotted lines, and in the lower figure of the reissue the width of the slot at the side next the bottom of the page is slightly greater than in the corresponding figure of the original patent.

Ans. I don't see any material difference.

Cross-int. 98. In the operation of the machine, is it material whether the width of the slots at the extremities is increased to such a limited extent as the difference between the two drawings shows with regard to the lower slot?

Ans. I think it is.

Cross-int. 99. Look at the drawings again, and state if there is any difference between the slots shown in the upper portion of the figures.

Ans. I am unable to determine, both slots not being shown the same.

Cross-int. 100. You say in your direct examination that you can't find any description of the form of the valve in the specification of the reissue patent. Did you make any examination of this patent, or its specification, before it was handed to you yesterday?

Ans. I did not.

Cross-int. 101. Did you read all the specification before you testified respecting it?

Ans. I believe I did.

Cross-int. 102. Could you tell from reading it what description of valve was described in it—rotary, slide, or otherwise?

Ans. I think I could. I understand it to be a rotary valve.

Cross-int. 103. Do you understand from the specification how that valve receives rotary motion?

Ans. I understand the valve is to receive rotary motion from the combined action of the two pistons, in connection with two cranks, a shaft and two bevel gears.

Cross-int. 104. Is there no description of the ports and channels of the valve and its method of operation contained in this specification?

Ans. No specified position for said ports, excepting that they shall be properly connected with the channels which supply the water at each end of the cylinders.

68 Cross-int. 105. Is that the only reference you find to the operation of the valve in the reissue patent?

Ans. It is, with the exception that they shall be placed in harmony with the cranks as each piston operates upon it.

Cross-int. 106. Knowing the position of the crank and the relative position that the ports of the valve must have therewith, as described in the specification of this patent, do you not think it probable that, if you had sufficient time to study the patent, you could construct a rotary valve which would operate in connection with the cranks and the slotted piston-rod, as described in this specification, reference being also had to the drawings which accompany it?

Ans. I don't think I could.

Cross-int. 107. With the knowledge which you acquired while in the employ of Ball and Fitts in 1869, could you do it?

Ans. Yes, sir.

Cross-int. 108. With the information you could obtain from patent No. 92,691, to Ball and Fitts, in 1869, could you do it?

(Objected to as immaterial, the patent of 1869 to Ball and Fitts not being referred to in the patent sued on.)

Ans. I think I could.

Cross-int. 109. Suppose you were informed that the Ball and Fitts patent of 1870 was an improvement upon the 1869 patent, would you think it necessary to give a full and minute description of the construction of the valve in the second patent, when the invention claimed therein was for certain other improvements operating in combination with valves of such general construction?

(Objected to because the question relates wholly to the witness's opinion as to the duty of a person writing the specification of the patent sued on, and is therefore wholly immaterial.)

Ans. No, sir.

Cross-int. 110. What is the office of a crank in mechanical movements? Is it not usually employed to convert reciprocating into rotary motion or vice versa?

Ans. I believe that is the general use of the crank.

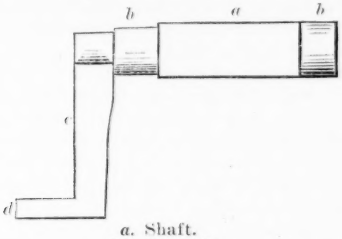
Cross-int. 111. Define what you mean by a crank-shaft.

Ans. I understand a crank-shaft to consist of a shaft with one or more bearings and a crank attached to it.

69 Cross-int. 112. Please look at the sketch I now make (marked Exhibit Sketch, C. F. S., Sp'l Ex'r), and state if that represents a crank-shaft as you understand it.

Ans. I should think this might be a representation of a crank-shaft.

Comp'ts' Exhibit Sketch.—C. F. S., Sp'l Ex'r.



a. Shaft.
bb. Journals.
c. Crank.
d. Crank-pin.

Cross-int. 113. Please examine the part of Exhibit 6 (Desper meter) which I now hand you, and state whether or not that is a crank-shaft, having two journals, a crank and crank-pin, substantially like that shown in Exhibit Sketch, the only difference between them being that the sketch does not show the enlarged portion of the shaft which forms part of the valve in the meter.

Ans. In my judgment, this is not a crank-shaft. The points of similarity between this and the sketch (Exhibit Sketch) are those which exist between every rotating valve and a crank-shaft.

Cross-int. 114. What are these points of similarity? Does it not have two journals, the same as the sketch? Does it not have the crank and crank-pin?

Ans. Yes, sir.

Cross-int. 115. What is the object of this device in the Desper meter? Is it not to convert the reciprocating motion of the piston into a rotary motion of the valve?

Ans. In my opinion, that is the purpose it was made for.

Cross-int. 116. Do you find in said Desper meter a rotary valve provided with suitable ports or openings through which the liquid to be measured can be supplied to the meter and be discharged therefrom?

Ans. Yes, sir.

Cross-int. 117. Do you find cylinders for the reception and measurement of the liquid?

Ans. Yes, sir.

Cross-int. 118. Do you find two double-acting pistons, each carrying a connecting rod, provided with a single cam slot, through which a crank-pin and crank motion is imparted to the valve?

Ans. Yes, sir.

Cross-int. 119. Are the slots in the rods of greater width than the diameter of the crank-pin?

70 Ans. Yes, sir.

Cross-int. 120. Do you find adjusting stops in the ends of the cylinders or cylinder-heads, said stops consisting of screws passed in from the outside?

Ans. I find a screw inserted through the head that in my opinion is there for that purpose.

Cross-int. 121. Please examine defendants' Exhibit Ericsson Patent, and says whether or not you see therein shown or described any adjusting stops.

Ans. I find in the specification that the piston of the Ericsson meter is stopped on the upward stroke by washer *y* put on the piston-rod, which comes in contact with the cylinder-head, the length of the stroke being determined by the thickness of that same washer.

Cross-int. 122. Please read this specification, from beginning to end if you choose, and state whether there is one word in it which describes or suggests any adjustment of the stop.

Ans. I find a statement here which leads me to think the pistons must have been adjusted in order to measure accurately the amount of water passed through them.

Cross-int. 123. I am not asking you as to what you think; I am asking as a matter of fact whether or not the stops in the Ericsson patent are described as adjustable, or capable of being adjusted, so as to change the stroke of the piston.

Ans. I do not find the words "adjustable stop" in the specification.

Cross-int. 124. Are the stops described as being adjustable, or not?

Ans. The stops are said to be used in this meter for the purpose of determining the range of the motion of the piston.

Cross-int. 125. (Question repeated.)

Ans. I have no further answer to make to the last question.

Cross-int. 126. (Question repeated.)

Ans. My answer is all that I am able to make, as I said before.

Cross-int. 127. After the stroke of the piston is determined, as described in the Ericsson patent, is there any description in the
71 specification which suggests that the length of the stroke of the piston may be changed by adjusting the stops?

Ans. I do not find any such description.

Cross-int. 128. Please look at Fig. 2 of the drawing (Ericsson patent), and state whether or not you could remove or substitute another washer for the washer *y*, without taking off the upper half of the cylinder and disconnecting it from the piston-rod.

Ans. From this drawing I don't think I could.

Cross-int. 129. What description of valves are shown and described in this Ericsson patent, and how are they operated in Fig. 2?

Ans. They are slide valves, operated in one instance in Fig. 2 by a rotating eccentric and connecting rod.

Cross-int. 130. I quote from the specification, "The diameter of the crank-pin is less than the capacity of the slot, so that at the end of each stroke the crank shall pass through a portion of its rotation without moving the piston. The extent of this side pendant motion is indicated by a triangle drawn in red lines." Please look at Fig. 2 of the drawings, and say whether or not you can find any indication of this motion of the crank-pin.

Ans. I find the dotted lines that indicate the different positions the crank-pin must occupy during the stroke in question.

Cross-int. 131. The side to that triangle is drawn from the centre of the shaft, is it not?

Ans. I believe it is.

Cross-int. 132. Now suppose the piston to be on the downward stroke, the crank-pin in contact with the upper wall of the slot, at what point will the crank-pin lose contact with the said wall of the slot?

Ans. It leaves the point of contact with the upper wall of the slot at the completion of the stroke as indicated by dotted lines on the right-hand side.

Cross-int. 133. When it reaches that point, I understand the valve would be closed, would it not?

Ans. I think it would.

Cross-int. 134. And if the machine was operating perfectly, the pin would move over to the left dotted line, would it not, without
72 contact with the walls of the slot, the valve beginning to open when the pin reaches the point shown on the left hand by dotted lines?

Ans. Yes.

Cross-int. 135. Now suppose that piston is working hard in the cylinder, for instance by mud or other obstructing material accumulating in the bottom of the cylinder sufficient to prevent it descending below the point at which the crank-pin should leave contact with the wall of the slot, at which point the valve is closed, how is the crank-pin going to pass over to the other side to open the port? Will it not in such case come in forcible contact with the lower wall of the slot? And should the piston in the other cylinder be working free, would the effect not be to stop the meter at that point or break the crank-pin?

Ans. I think it would.

Cross-int. 136. Do you know whether or not these Ericsson meters have ever gone into public use; and, if not, what has been the objection to them?

Ans. I don't know that they ever were in public use. In my opinion, the friction caused by so much machinery would make them impracticable where there was no great pressure of water.

DANIEL C. FISHER.

Attest.

CHAS. F. SLEEPER,
Special Examiner.

Deposition of Henry A. Desper.

BOSTON, *Jan.* 26, 1877.

Direct examination by JAMES E. MAYNADIER, esq., of counsel for defendants.

Int. 1. What is your name, and are you one of the defendants in this case?

Ans. Henry A. Desper. I am.

Int. 2. What is your occupation, and how long have you been engaged in it?

Ans. A pattern maker and practical draftsman, also a manufacturer of water meters. I have been working on patterns for five
73 years, and meters the same length of time. I was a draftsman for some years before that.

Int. 3. Are you the inventor of the meter described in letters patent 144747, dated Nov. 18, 1873? (The original patent is here put in evidence.)

Ans. I am.

Int. 4. Look at the complainants' Exhibit 5, and state whether you are familiar with the construction and operation of meters like that generally, and state what defect, if any, you find in that meter relating to the relative width of the slots across the piston-rods, and the diameters of the wrist-pins; and explain how this defect, if any, affects the practical operation of the meter, and why; and how the meter should be constructed in this respect, and why.

Ans. I think I am familiar with the construction and operation of meters like that (Exhibit 5). I find that the slots in the piston-rods appear to be considerably worn, and also the wrist-pins, or friction-rolls on the wrist-pins, appear to be wasted away either by rust or wear, so as to leave considerable play at the ends of the slots in the piston-rods. In operating upon the crank-pin it ceases to act sooner than it would were it narrower, and also fails to reinforce the motion of the crank-shaft after the crank passes its dead centre. In my opinion it should be constructed with the slot narrower at the ends, allowing just enough play on the wrist-pin to avoid friction, while at the centre it should be wider than the wrist-pin to permit the crank to freely pass its dead centre, while the piston is at rest, by coming in contact with the stop. The practical operation is that it does not close the valve as soon as it would were it narrower, and also fails to open the valve port to the otherside of the piston after the crank passes its dead centre.

Int. 5. Suppose that meter (Exhibit 5) to be in operation, and suppose one of the pistons to have just completed its stroke, that is that its motion has just been stopped by the screw projecting from the end of the

piston-rod coming in contact with the cylinder head; and state how the valves would then be, how the two cranks would be, and how the other piston would be.

Ans. I find the crank of the piston just stopped I should think about thirty-five degrees from the dead centre, as near as I could
74 judge; the other crank I should say about seventy-five degrees from the other centre on the opposite side of the crank-shaft. I find the port leading to the cylinder just filled is about one-third open, and the port to the cylinder which is operating the other crank referred to is about two-thirds open. The other piston would be a little less than half its stroke. The exhaust ports should sustain the same relation to the cylinders discharging as they do to the cylinders filling: this would relate something to the lap of the valve, more or less lap—I cannot state how much lap there is.

Int. 6. Now, when the piston, supposed to be at a stand-still, remains at rest, with its crank at first thirty-five degrees from the dead centre, what closes its inlet and outlet ports, and where is the other crank when those valves are wholly closed?

Ans. The action of the opposite piston upon its crank, and that crank is in a vertical position, while the crank of the piston at rest is on its dead centre.

Int. 7. How many degrees is the valve rotated by, say, ninety degrees rotation of the crank-shaft?

Ans. I should say thirty degrees.

Int. 8. How near to its dead centre will the crank of the moving piston get before the valves of the other piston open far enough to cause the slot in the piston-rod to that piston to take on the wrist-pin in that slot?

Ans. I should say about eighty degrees from it.

Int. 9. With slots as wide as those shown in Exhibit 5, what will be the practical effect as to one piston interfering with the motion of the other, or as to one piston taking less promptly than it should upon its wrist-pin? Please explain this.

Ans. I don't think it would have any effect upon the action of the other; but the slot being wider than the wrist-pin, the piston has to travel a short distance after the ports are opened before it reinforces the motion of the crank, and thus the valve does not act as quickly as it would if the slot were narrower.

Int. 10. What is the practical consequence of this sluggish action of the valve, if any?

Ans. It does not open the ports to the piston just commenced to operate as soon as it would be desirable.

75 Int. 11. What is the practical consequence of not opening these ports soon enough?

Ans. It does not allow the proper supply of water in the cylinders.

Int. 12. What is the practical consequence of that?

Ans. The action of the other piston causes the crank-pin to bind upon the wall of the slot.

Int. 13. What caused the wear on the slots in Exhibit 5?

Ans. The action of the crank-wrist coming in contact with the walls of the slot. In my opinion, on one side of the slot the action of the slot on the crank-pin to operate the crank-shaft, and the wear on the other side of the slot caused by the action of the wrist-pin forced against it by the action of the opposite piston by the rotation of the crank-shaft.

Int. 14. You state that the slots in the piston-rods should be wide enough, except at the middle, to be loosely fitted by the wrist-pin, and

at the middle cut away to allow the wrist-pin to move freely from a short distance above to a short distance below the dead centre. Now look at Exhibit 1, patent No. 109372, and state how the slots are there shown and described.

Ans. It is shown in Fig. 1 with the crank being in a vertical position, consequently at the lower end of the slot it appears to nearly fill the width of the slot. The crank at the other end of the crank-shaft would be at the middle of the length of the slot, and shows a little play between that and the walls, and it is described as not parallel or straight, the slots being wider at the middle than at the ends.

Int. 15. Can you find anything whatever in the specification indicating or suggesting that the wrist-pin should not fit the slot as wrist-pins usually fit slots, except where the slots are cut away on each side?

Ans. I do not.

Int. 16. Have you examined and do you fully understand the specification and drawing, Exhibit 4, reissue No. 5806?

Ans. I have examined them, and understand them as fully as I can from the description given.

Int. 17. State whether the meter could be constructed by a
76 mechanic skilled in the manufacture of water meters, but having no other knowledge of that particular meter than he could obtain from that specification and those drawings; and explain fully what difficulties, if any, such a mechanic would meet with.

(Objected to unless confined to the skill and experience of the witness.

Defendants' counsel here calls attention to the fact that the witness is qualified as an expert on this point, as appears from his second answer, but is willing that complainant's counsel should now cross-examine him as to his qualification, if he so desires.

Counsel for complainants raises the objection because it calls upon the witness to testify as to facts which cannot be within his own knowledge, to wit, asking him whether other skilled mechanics would or would not be able to construct this meter.

The question is thereupon amended by adding:)

Your opinion is what is asked for, and you will please state fully your reasons for that opinion.

Ans. In my opinion he could not construct this machine with only the specification and drawing. By reference to the specification it states, Fig. 1 represents a plan of the meter, whereas in the drawings Fig. 2 represents a plan, whereas Fig. 1 is a vertical section; and the statement in the specifications, Fig. 2 represents a vertical longitudinal section taken through line x—x of Fig. 1. It is evidently a mistake in numbering the figures. I find line x—x, Fig. 2, and taking Fig. 2 as the standard, Fig. 1 is not a correct representation of the section taken through said line, as, in the first place, the wrist-pin is shown being in front of the crank, the end of the shaft as being flush with the crank, the piston-rod as being back side to you; whereas, to be correct, the shaft i should be shown in section lines, the wrist-pin as behind the crank, that is, in dotted lines, and the slot in the piston-rod extending the full width of said rod. This representation is evidently meant to represent a section taken along line x—x by reference to the letters, as on the other cylinder they are represented by letters b' and c. To be strictly correct, Fig. 3 should represent the part cut off in Fig. 2. Fig. 4 is not correct, as the slot is not shown as it should be, as the full shape
77 of the slot should be shown, as much as the crank-shaft or bevel gear, as also the concavities in said slot. The cylinders and

heads are shown as being in one piece and set in cement, which would interfere very much with adjusting the stops; and the slot is further represented in a manner that would mislead a mechanic in constructing it. Fig. 2 represents shaft *i* as being unsupported, and no journals appear in the drawing. It also represents a framework over the valve, which might be for the purpose of holding the valve to its place.

Int. 18. Your answer is not quite full. Please consider now what difficulty, if any, a skilled mechanic would find in making a valve to answer the requirements of the specification, and in properly combining that valve with the cylinders and the parts that actuated it.

Ans. I think it would require further invention, because the valve is not shown in either of the drawings clearly enough for a mechanic to form any idea of what it is.

Int. 19. What, if anything, are you able to find in the specification or drawings, in regard to the proper speed of the valve in relation to the speed of the crank-shaft?

Ans. I do not discover anything.

(Noon recess.)

Int. 20. Please compare Fig. 2 of the reissue with Fig. 1 of the original, and state what material change, if any, has been made in the former, and read to the magistrate any language in the reissued specification which you believe to be based upon this change, and which is not found in the original specification.

Ans. In Fig. 2 of reissued patent No. 5806, the wrist-pin of the crank at the lower part of the figure is shown to be fitted very loosely in the slot; the proportion of the width of the slot is represented as being much greater than in the original patent No. 109372, being shown in the original as very nearly filling the slot, as I have stated before. In the specification I find as follows in relation to the piston-rod, which says, it is "provided with a cam-slot formed at an angle with the path of motion of the piston, and of a proper width, the said slot shall suffice to permit the adjustment of the pistons, that the cylinders may discharge at each
78 end alternately neither more or less than the exact quantity of water required; and shall also suffice, when the further advance of the piston shall have been thus arrested by the stops, to permit the crank to turn without acting on, or being acted on, by its own piston, as, for instance, when its crank-shaft is acted on by the adjoining piston for the purpose of opening the ports to the other side of the piston just stopped, and which it otherwise could not do were the slot not widened sufficiently for that purpose." Also it states, "It will be seen that we make the general width of the slot *e* somewhat greater than the diameter of the wrist-pin *n*." That is all that I find in relation to the slot.

Int. 21. Is there more than one office ascribed to the stops in the original patent? If not, what is that office?

Ans. There is only one office ascribed to the stops. It is for the purpose of stopping the pistons when they reach the end of the stroke.

Int. 22. With a slot as is shown in the original patent, the wrist-pin fitting the slot everywhere but in the middle, can the stops be practically used in order to vary the quantity of water discharged? And, if not, what change is necessary in the slots to enable the stops to be practically used for this purpose?

(Objected to as misleading, as the original patent does not fit the slot as suggested by the question.)

Ans. I think not; they should be made wider throughout.

Int. 23. Have you examined the patent now shown you (Exhibit Ericsson Patent), and do you understand the construction and operation of the meter there shown, especially at the left of Fig. 1 and in Fig. 2?

Ans. I have, and I think I understand it.

Int. 24. Please compare that meter with the meter described and shown in Exhibit 4 (using Exhibit 5 to correct any errors in the description and drawings of Exhibit 4), and state how they resemble or differ from each other substantially.

Ans. They resemble each other very much, with the exception that one operates with a rotary valve and the other with a slide valve; two double-acting pistons, two piston-rods with slots formed across said rods, two cranks, two crank-pins, one crank-shaft, and stops being found in both. The piston-rod is formed with a slot across it, the
79 wrist-pin being of a less width than the slot. I don't want to be understood that two rods with slots are shown in the drawings.

Int. 25. What difference, if any, can you discover between the operation of the stops in the Ericsson meter in connection with the widened slot and small wrist-pin, and the operation of the like parts in the Ball and Fitts reissue (supposing the slot in that reissue to be widened throughout instead of being made as shown and described in the original patent), so far as concerns either their operation to allow the wrist-pins to move freely past the dead centres, or their operation to affect the quantity of water discharged?

Ans. I think they are for the same purpose. I think the operation is substantially the same.

Int. 26. Are you familiar with the patents now shown you, viz, No. 78551, dated June 2, 1868, to Sutherland; No. 55547, dated June 12, 1866, to Spencer and Meyer; No. 50651, dated Oct. 24, 1865, to Barden (all of which are now put in evidence and marked respectively Exhibits Sutherland patent, Spencer and Meyer patent, and Barden patent, C. F. S., special examiner), and the Ball and Fitts, 1869, patent, and do you understand the construction and operation of the meters there shown? If so, state in detail what part each of these meters has in common with the Ball and Fitts reissue, as exemplified by Exhibit 5?

Ans. I have examined them and think I understand them. In the Sutherland meter, 78551, I find two double-acting pistons, two piston-rods with slots across the rods, one common crank-shaft, and two wrist-pins on one common crank-shaft, said wrist-pins communicating rotary motion to the shaft by the action of the piston-rods, and situated at a right-angled position, or thereabouts, relatively to each other, so that one is operating the shaft while the other is on its dead centre. In the Spencer and Meyer patent, 55547, I find two double-acting pistons, two cranks set at right angles to each other on the shaft, one common crank-shaft, and slots formed in the piston-rods across them. These slots transmit rotary motion to the crank-shaft. In the Barden patent, 50651, I find it to contain two double-acting pistons, two cranks, and the action of these pistons is in such relation to each other that one crank is passing its dead centre while the
80 other piston is at its half stroke. In the Ball and Fitts, 1869, patent, I find two double-acting pistons connected together by a rod, having slots in it, a crank-shaft, rotary valve, crank-pins operating this crank-shaft, and these crank-pins are so situated that one double-acting piston is operating the crank-shaft while the other piston is changing its reciprocating motion. This crank-shaft communicates rotary motion to the valve. This valve is also described as a conical valve.

Int. 27. Suppose a skilled mechanic to have full knowledge of the Ball

Ball & Fitts.

Water Meter.

No. 109,372. Patented Nov. 22, 1870.

Fig 2

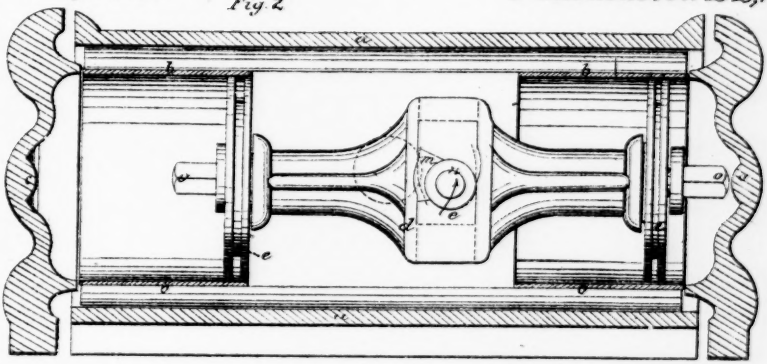
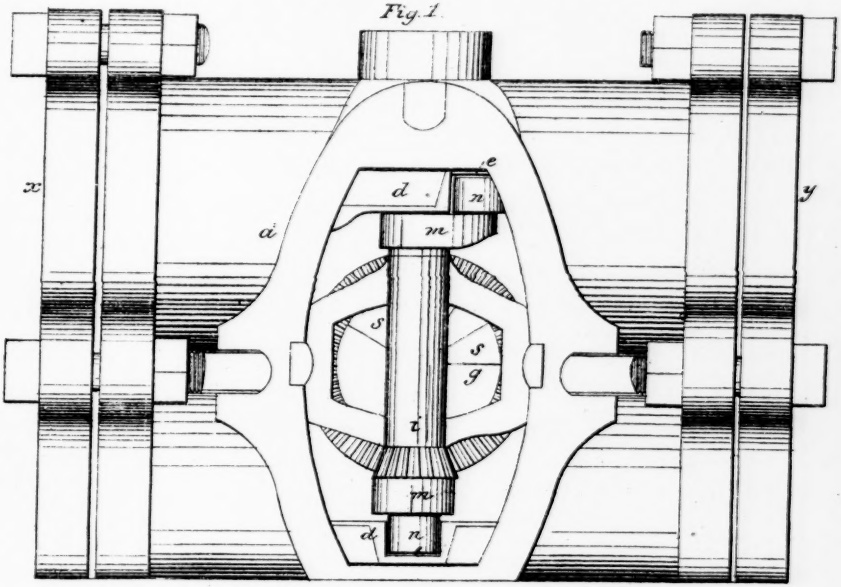


Fig. 1



No. 209.
Union Water Meter Co.
v. Desper
Page 10.

Witnesses
John C. Otis
Abraham Fitts

Inventors
Phinehas Ball
Benaiah Fitts

2 Sheets--

P. BALL & B. FITTS.

Liquid-Meters.

No. 5,806. Reissued March 24, 1874.

Fig. 3.

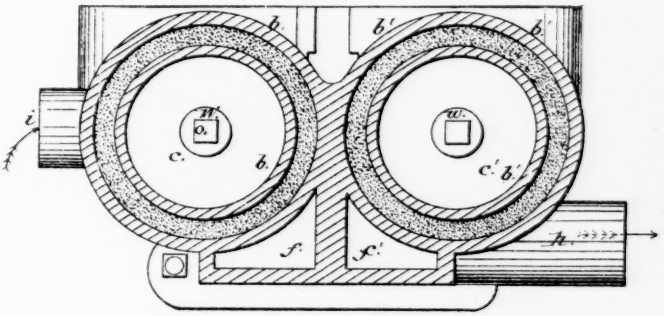
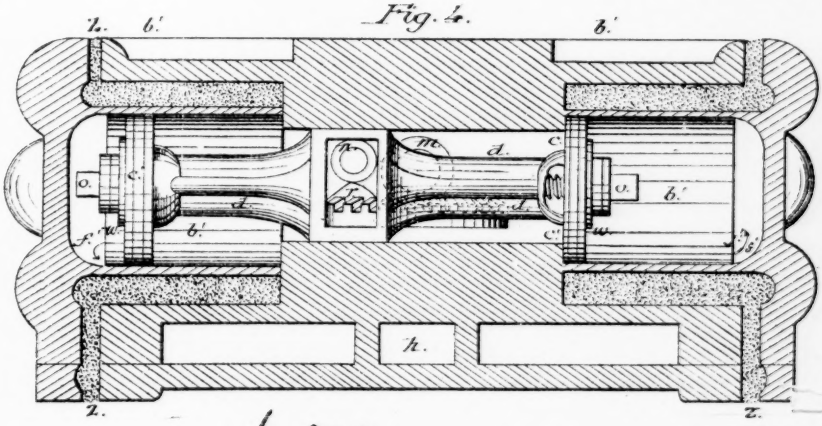


Fig. 4.



No. 209.

Witnesses.

C. Stuart
G. H. Knight

Union Water Meter Co.
v. page 14.
Despar

Inventors.

Phinehas Ball
Benanah Fitts
per
P. Hann
Attorney

U. S. C. C. Maps Dist.
Union Water Meter Co.
vs.
Desper et al.
Defts Exhibit
Additional Drawings
P. B. Stetson
Commissioner
Apr. 9th 1877

No. 209
Union Water Meter Co.
vs.
Desper
Page 182

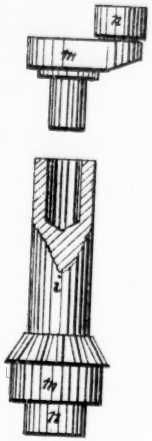


Fig. 5.

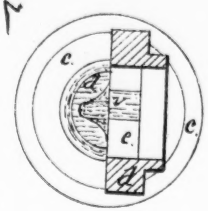
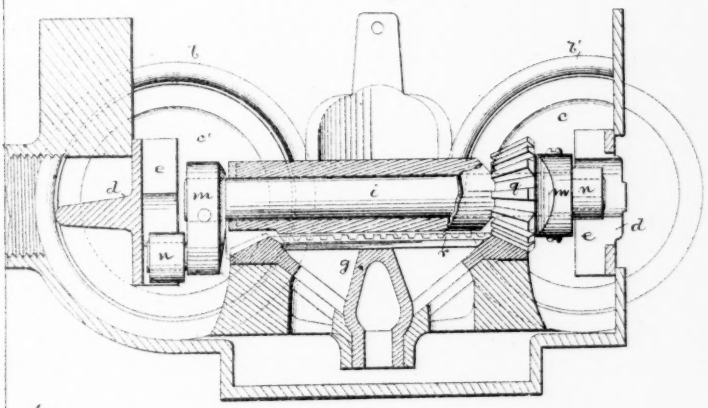


Fig. 6.

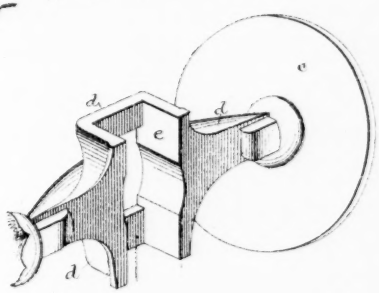
Exhibit "Dome Drawing"
P. B. Stilson
Commissioner

Apr. 9th 1877



Section.

No. 209
Union Water Meter Co.
D. Page, 182
Desper



Isometric View of Connecting Rod &c.

2 Sheets- Sheet 1.

P. BALL & B. FITTS.

Liquid-Meters.

No. 5,806

Reissued March 24, 1874.

Fig. 1.

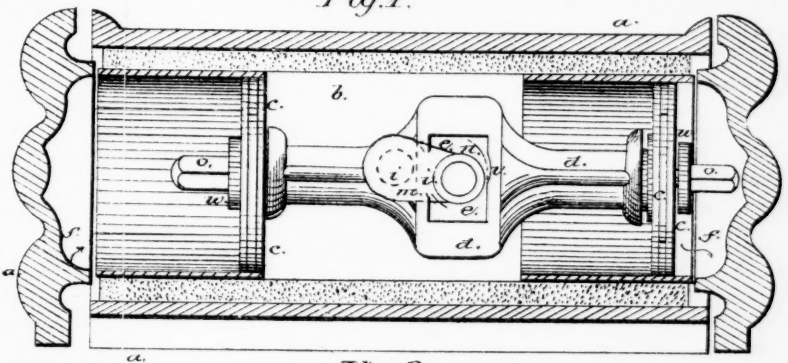
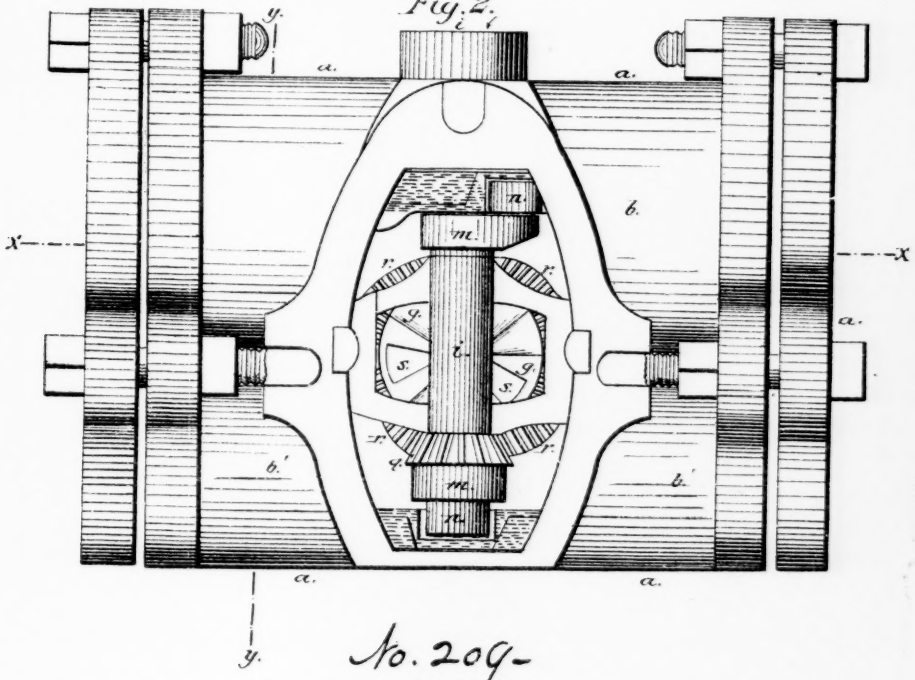


Fig. 2.



No. 209-
Union Water Meter Co.
D. Desper
page 14-

Witnesses.
D.G. Stuart
M. Kenaph

Inventors.
Phinehas Ball
Benajah Fitts
per
P. Hann
Atty

and Fitts, 1869, patent, and state whether he could construct the meter shown in the Ball and Fitts reissue, 5806, from the specification and drawings of the reissue, aided by the 1869 patent; and give your reasons for any opinion you may express.

Ans. I think it would require further invention, as it does not show clearly the manner of introducing the valve.

Int. 28. What is the main purpose of arranging the cylinders in your meter crosswise and on the same plane, instead of having them parallel, as in the Ball and Fitts meters, and in other meters described in some of the patents put in evidence?

(Objected to as immaterial.)

Ans. To obtain a direct action of the valve, without the use of intermediate devices between the piston-rods and the valve, with the exception of one crank.

Int. 29. Do you know or have you ever heard of any other meter than yours in which two piston-rods have a direct connection with the valve?

(Same objection.)

Ans. Not arranged with four piston-heads and two piston-rods.

Int. 30. What equivalent, if any, can you find in your meter for the crank-shaft described in the Ball and Fitts reissue?

Ans. Not any.

Int. 31. How many Ball and Fitts meters, like Exhibit 5, have you ever examined carefully; and in how many of them was the slot made so wide throughout that the wrist-pin didn't fill it substantially; that is to say, how many had slots and wrist-pins like those in Exhibit 5, and how many like those in Exhibit A?

(Objected to as immaterial.)

Ans. I never examined any but this one, Exhibit 5, with screws
81 and washers forming stops, that was formed as the slot is in Exhibit 5; that is, the wrist-pin being as small in proportion as it is in Exhibit 5. I have examined quite a number of the style of Exhibit A; could not state the exact number, but in every case where I was particular to notice this slot, it was made of a width a little in excess of the diameter of the wrist-pin, and of which I should say Exhibit A represents a fair sample.

Int. 32. Read the claims one and three of the reissue, and state whether the parts therein named are operative for any purpose known to you, without using any other parts with them.

Ans. I think they are inoperative used alone.

Cross-examination by ANDREW MCCALLUM, esq., of counsel for complainants:

Cross-int. 33. When you testified respecting Exhibit 5 (ints. 4 to 14), were the parts of said meter all arranged in working order, or was the meter partly apart and partly together?

Ans. It was partly in pieces; the part I referred to more especially seemed to be where it should be, as I understand the machine.

Cross-int. 34. In answer to int. 5, you state that you find the crank of the piston just stopped about thirty-five degrees from the dead centre, while the other crank is about seventy-five degrees from the other centre. Please explain how this is possible when the cranks are arranged at right angles to each other on a common shaft.

Ans. I stated that I judged it to be about this angle from looking at the exhibit. To be mathematically correct, it might vary from this. The exhibit as I looked at it appears to be sprung. I suppose to be mathematically correct it should be fifty-five degrees.

Cross-int. 35. Do you mean to say that the cranks of the exhibit are not arranged at right angles to each other, but differ twenty degrees from a right angle?

Ans. Perhaps not as much as that, but I think they are not exactly ninety degrees.

Cross-int. 36. Then the statement you made in answer to int. 5 is erroneous, is it not?

Ans. In a strictly mathematical sense it would be, but I judged from inspecting the machine.

82 Cross-int. 37. Are other statements you have made with respect to this Exhibit 5 to be taken with the same qualification as to their accuracy?

Ans. I should say they were; the machine being in pieces, and some parts being worn, I should say it would be difficult to make minute statements regarding it.

Cross-int. 38. If the operating parts of Exhibit 5 were as you have stated in said answers 4 to 14, or nearly so, would the meter (Exhibit 5) operate at all, in your opinion? I refer you particularly to your answers to ints. 5, 9, and 12.

Ans. I think the meter would operate, but not to its best advantage.

Cross-int. 39. Do you not think that that meter (Exhibit 5), when put together, will not operate so as to measure water accurately and indicate the amount measured?

Ans. I think it would operate, but would be liable to not register the correct amount under all circumstances.

Cross-int. 40. Why?

Adjourned.

BOSTON, *Jan.* 27, 1877.

Ans. Because if in adjusting the piston by the screws and washers forming the stops, so as to give the right amount of water, it requires that the wall of the slot should go say one-eighth of an inch beyond the path of motion of the wrist-pin, the piston would not make its full stroke if from any cause the piston run hard in the cylinder, therefore would not give the full amount of water required, but would register the same as if it made a full stroke; whereas if the slot in the piston-rod were adjusted so as to just allow the crank-pin to pass its dead centre, and the piston did not complete its stroke by its own action, the crank would compel it to complete its stroke; and then if there were concavities in the sides of the slot, the motion of the piston is completed before the crank reaches the dead centre, at which point the valve ports should be closed; in my opinion the piston is adjusted to the motion of the crank, and not for the purpose of determining the amount of water delivered, there being nothing said of adjusting stops in the original patent.

83 Cross-int. 41. The question does not refer to anything in any patent, but to the meter, Exhibit 5. Will or will not, in your opinion, said meter register and measure water correctly notwithstanding all the alleged defects in its construction which you have spoken of in your testimony? This question calls for an answer in the negative or affirmative.

(Defendants' counsel here instructs him that he may answer the question as he sees fit, regardless of the concluding paragraph in it.)

Ans. Exhibit 5 being in pieces, I am unable to give the opinion that I should were it in proper working order.

Cross-int. 42. You have already stated that if the machine were all put together you think it would measure water but not register it correctly. I now ask if you cannot give an opinion whether or not it would

not only measure correctly but register correctly when put together. You can surely give your opinion as to whether it will or will not.

(Objected to because the question has been already answered, as stated in the question itself.)

Ans. I should think it would not the same as it would when it was new.

Cross-int. 43. You say that you have been engaged in the meter business five years, and was a draftsman for some years prior to that. Please state how many years prior you were engaged as a draftsman, in whose employment, and what description of drafting you were engaged in.

Ans. I was engaged more or less for two years in the employ of a builder, in making plans, details, etc. of buildings, etc., and during the same time I was engaged in making drafts of different inventions that came along.

Cross-int. 44. What inventions, for instance?

Ans. Meters, for instance. I refer to my own invention and also to an invention of my father's.

Cross-int. 45. Did you make the drawings for your father's patent? If so, when were they made?

Ans. Not the ones that the patent was allowed on.

Cross-int. 46. How old are you now?

Ans. Twenty-five years and six months.

84 Cross-int. 47. In answer to int. 14, you refer to Fig. 1 of Exhibit 1. What does Fig. 1 represent?

Ans. A plan view of the machine.

Cross-int. 48. A top or bottom plan?

Ans. A top plan.

Cross-int. 49. That is, looking down on the top of the meter as I now look upon Exhibit 5?

Ans. Yes; with all the parts in position.

Cross-int. 50. Will you now look down on the top of that Exhibit 5 and state whether or not you can tell, by looking at it in that position, whether the slots in the connecting rods are widened in the centre or not?

Ans. I cannot; but can see a space between the wall of the slot and the inside of wrist-pin.

Cross-int. 51. Can you see any part of the walls of the slot except the top of them?

Ans. I cannot.

Cross-int. 52. Please explain, then, how you can see one of the cranks filling the slot and the other not filling it, but with a space on each side of it at the middle of the length of the slot.

Ans. I only see one wall of the slot as shown in the slot referred to.

Cross-int. 53. Is that the only explanation you can give of your answer to int. 14?

Ans. By referring to the specification it is.

Cross-int. 54. Do not the drawings of Exhibit 1 show that the width of the slot is slightly greater than the diameter of the wrist-pin, even at the ends of the slots, and considerably greater towards the centre, or midway the length of the slot?

Ans. In Fig. 1 the width of the slot is shown a little in excess of the diameter of the wrist-pin at the ends. It is still wider at the centre by the concavities.

Cross-int. 55. In your opinion could any practical adjustment of the length of stroke of the pistons by the adjustable stops be effected in

the meter described in the original patent if the extremities of the slots in the piston-rods were no wider than to permit of the wrist-
85 pin turning freely between the walls at that point, or could the adjustment referred to be accomplished by having the ends a true fit, and then gradually widening out?

Ans. In one direction it could not, I think; that is, the stroke could not be shortened, as shown here, without causing the wrist-pin to bind on the wall of the slot. As to second branch of question, I think that would be practically the same, to a certain degree, as widening the slot throughout.

Cross-int. 56. Is it your opinion that it is essential to have the slot of greater width than the diameter of the wrist-pin or friction-roll on the wrist-pin throughout the entire length of the slot, in order to permit of any adjustment or variation in the length of stroke of the pistons, in the manner described in the reissue patent No. 5806? I refer to the adjustment of the pistons so that the cylinders may discharge the exact quantity of water required.

Ans. I should think not, only enough to prevent friction.

Cross-int. 57. Is it your opinion that the adjustment referred to can be effected if the width of the slot is the same as the diameter of the wrist-pin throughout its entire length?

Ans. Not by the means described. I refer to the adjustable stops.

Cross-int. 58. Is it not a fact that in meters which have slotted piston-rods with the slots of the same width as the crank-pin throughout their length, the positions of the pistons with the relation to the crank-pins and slotted rods have to be nicely adjusted in the first instance, that their relative positions must be preserved, and that the length of the stroke of the piston cannot subsequently be varied without a corresponding alteration of the slot or crank?

Ans. Certainly.

Cross-int. 59. Such being the case, would it not, in your opinion, be a great improvement in the art if a meter of this general construction could be made with the slots so formed as to permit of a slight variation in the length of the stroke of the pistons, without having to alter the position or arrangement of the wrist-pin crank or valves, and still have the machine thoroughly efficient, the said adjustment of the pistons enabling you to change the quantity of fluid measured, say from two per cent. down to one-half per cent. or less?

86 Ans. I think it would, and has been done in the Ericsson meter before referred to.

Cross-int. 60. Do you speak of your own knowledge in regard to the Ericsson machine?

Ans. Yes, sir, as described in the patent specifications and drawings.

Cross-int. 61. You say it has been done in the Ericsson machine. Do you know that from your own personal knowledge and experience with the Ericsson machine, or is that only an opinion derived from your knowledge of the Ericsson patent?

Ans. It is the opinion derived from the said patent, and also from the knowledge that every machine has to be adjusted before it will do its proper work.

Cross-int. 62. We are supposing that all machines have been properly adjusted in the first instance, the parts being all arranged in their proper relative positions; but that after being in operation, say for some time, from some cause or other they fail to work properly, the defect being in the stroke of the piston, and that with the improved machine we can adjust the stroke of the piston without having to alter the other parts

referred to. Will you please explain in what manner you can accomplish this result in the Ericsson machine as described in the Ericsson patent you refer to?

Ans. By interposing a washer of different thickness for a stop in place of *y*, or put a washer on the upper end of the rod.

Cross-int. 63. Please explain how you could change the washer *y* for a thicker or thinner one in that machine. Would you not have first to remove the upper portion of the cylinder and detach the piston-rod from the piston?

Ans. I should remove the bottom of the cylinder, then remove the piston and interpose the washer.

Cross-int. 64. How could you remove the piston, when the bottom is removed, so as to get at the washer, when the yoke *t* on the end of its rod is of much greater width than the hole through the stuffing-box and the upper portion of the cylinder, the washer *y*, which you refer to, being on the upper side of the piston? And please explain also how
87 you would get a washer on the piston-rod, on the under side of this slotted yoke *t*, which is shown as part of the piston-rod, and so described in the patent.

Ans. If the piston-rod and yoke are in one piece, then the fastening to the piston must be at the end where the piston is, and I would remove this fastening, take out the piston, and thus get at washer *y*. And to the other branch of the question, I would use a spring washer.

Cross-int. 65. Is that method of changing the stroke of the piston, or any method or device for effecting such change, described in the Ericsson patent? If so, please quote the language which describes it.

Ans. It is not so described. In int. 62 we were supposing a case as to how it could be done, and the foregoing relates to that supposition.

Cross-int. 66. You said in answer to int. 59 that this adjustment has been done in the Ericsson meters; and in answers to 60 and 61, you say you derived such knowledge from the specification of the Ericsson patent, did you not?

Ans. I did.

Cross-int. 67. In your own patent, No. 144747, the slots in the piston-rods are shown as of the same width as the diameter of the crank-pin, are they not? I refer particularly to Fig. 1 of the drawings.

Ans. Yes, sir; but there is nothing claimed on this.

Cross-int. 68. How is it with the meters you manufacture yourselves, of which Exhibit 6 is said to be a fair specimen?

Ans. The slot is wider than the wrist-pins, but appears to be the same width throughout its length.

Cross-int. 69. Why do you make this difference in the construction of this part of your meter from the patent?

Ans. To allow of the adjustment of the pistons, as described in the patent, for determining the amount of water delivered.

Cross-int. 70. How are the pistons adjusted as described in the patent? Quote the language of the specification which refers to such adjustment.

Ans. "The set screws *k*, through the cylinder heads, as above referred to, afford adjustable abutments for stopping the pistons at
88 the outer terminations of their strokes at such points as will allow them to discharge the proper amount of water."

Cross-int. 71. Do you refer to the set screws in the cylinder heads, as in Exhibit 6?

Ans. I do, with the exception that in Exhibit 6 the set screw has been adjusted and the head cut off.

Cross-int. 72. Why do you cut the heads of the screws off?

Ans. Because after being once adjusted there is no further use for them.

Cross-int. 73. Since when did you begin to cut the heads off these screws, as near as you can remember?

Ans. Since the spring of 1875, I think.

Cross-int. 74. Have you since the spring of 1874 ever made or sold any water meters having the slots in the piston-rods of varying or unequal widths throughout their length?

Ans. I think not up to the time that this present suit was brought.

Cross-int. 75. Have you since the commencement of this suit?

Ans. I have made some with the slot of unequal width, but it was wider at the ends than in the middle of the length of the slot.

Cross-int. 76. Have you made any with the slots wider at the middle than at the ends of the slot?

Ans. I do not recollect any.

Cross-int. 77. Will you swear that you have not?

Ans. I will not, as we might have made a few as an experiment, or something of that kind.

Cross-int. 78. Have you sold any having the slot wider at the centre than at the ends?

Ans. I cannot state. We have some meters in stock now, and they might be among them.

Cross-int. 79. Then you have made meters of this description, and may have sold them; is that your answer?

Ans. If you speak of the mathematical accuracy of the slot, we may have made some of that description, but not for the purpose that it is used in Exhibit 4.

Cross-int. 80. The question of mathematics has nothing to do with it. The question is, Have you or have you not made and sold
89 meters in which the slots are purposely made wider in the middle than at the ends?

Ans. I do not recollect of any.

Cross-int. 81. In your answer to the bill of complaint you make oath to the following alleged fact: "6. That every water meter made and sold by them was and is made, constructed, and operated in the manner described in letters patent of the United States granted to one of these defendants, Henry A. Desper, dated Nov. 18, 1873, and numbered 144747, for 'Improvement in fluid meters,' as the inventor thereof, with the exception that in the meters made by these defendants, instead of the adjusting screw K, as shown in the patent, a plug is inserted and cut off," the fact being that you construct the meters with the slots of the piston-rods, not as shown in said patent, but with widened slots, that is, with slots much wider than the diameter of the wrist-pin, for the purpose of permitting the adjustment you referred to, and the further fact that you use screws for the stops, and not simply plugs. Do you consider said statement contained in your answer strictly true?

(Noon recess.)

Ans. I do. The description in the patent states as follows in relation to the slot: "The connecting-rods have slots *s* made transversely through them at the middle of their length, through which slots passes freely the wrist-pin H, of a crank F." The other parts referred to in the question are not materially different from those described.

Cross-int. 82. Please to look again at the Ericsson patent and state what kind of valve is therein shown and described, and how many there are of them to a meter.

Ans. A slide valve. Two of them.

Cross-int. 83. Are they not described as such valves as are used in high-pressure steam-engines?

Ans. They are in one place so described.

Cross-int. 84. In your opinion, could such a description of slide valves be used successfully in place of the single rotary valve in the Ball and Fitts meter or in your own meter?

Ans. Not without further invention.

90 Cross-int. 85. Please to look again at the Sutherland patent, and state how many valves you find in that patent, and what kind of valves they are.

Ans. Two slide valves.

Cross-int. 86. How many sets of valve ports?

Ans. Four.

Cross-int. 87. You say in answer to int. 26 that you find one common crank-shaft and two wrist-pins. What is the object and purpose of this crank-shaft, as you understand it?

Ans. That the pistons shall sustain the same relation to each other, that is, when one is at the end of its stroke the other shall be at its half stroke.

Cross-int. 88. Is the crank-shaft used for operating the valves in that Sutherland patent?

Ans. It is not.

Cross-int. 89. Are the slots in the piston-rods what has been called widened slots, or are they of the same width as the diameter of the wrist-pin?

Ans. By reference to the drawing, Fig. 2, I should judge that they were slightly in excess of the diameter of the wrist-pin, enough so as to prevent friction.

Cross-int. 90. Are they of equal width throughout their length, or wider at the middle than towards the extremities?

Ans. I should judge them to be of an equal width.

Cross-int. 91. Do you find any adjustable stops shown or described in said patent?

Ans. I do not.

Cross-int. 92. Please look again at the patent of Spencer and Meyer, and state what kind of valves are shown and described in that patent, and how many of them there are.

Ans. Two slide valves operated by a crank-shaft.

Cross-int. 93. Are they not operated by eccentrics on a crank-shaft, the same as in an ordinary steam-engine, and is it not stated in the specification that they operate after the well-known method of converting reciprocating into rotary motion?

Ans. I think it is so stated.

91 Cross-int. 94. Are the slots in the piston-rods widened or of uniform width throughout their length?

Ans. I should judge them to be of uniform width, and the wrist-pin fitted to the slot in a manner usual in steam-engines.

Cross-int. 95. Are any stops shown and described in this Spencer and Meyer patent limiting or adjusting the stroke of the pistons?

Ans. Not of the style found in some other meters. The wrist-pin of the crank forms a stop and thereby determines the range of motion.

Cross-int. 96. Is there any way of varying the length of the stroke shown or described in the patent?

Ans. There is not.

Cross-int. 97. Please look again at the patent of Barden, 1865, and

state what description of valves is therein shown and described, and how many there are of them.

Ans. Two slide valves, each operated by a crank-shaft.

Cross-int. 98. There are two crank-shafts, are there not, one for each slide valve?

Ans. There are.

Cross-int. 99. Do you find any piston-rods having slots in which the crank-pins of a crank-shaft operate?

Ans. I do not.

Cross-int. 100. Do you find any stops for limiting or adjusting the stroke of the pistons?

Ans. None other than the crank on the crank-shaft which limits the motion of the pistons.

Cross-int. 101. Please look again at the patent of Ball and Fitts, 1869, and state what it is you refer to as a crank-shaft in that machine. Do you mean the shaft E with two disks and four pins?

Ans. I do.

Cross-int. 102. Do you understand how the revolution of that shaft is accomplished by the two disks and the four pins? If so, please explain it.

Ans. I think I do, but it would require more than this drawing to explain it.

92 Cross-int. 103. Can you state with certainty whether or not it is a crank motion?

Ans. I should think it was, but not the same as a single crank exactly.

Cross-int. 104. In your opinion, is it the same device as shown and described in the reissue patent No. 5806?

Ans. Not exactly the same.

Cross-int. 105. How many cam slots are there in the piston-rod of the 1869 patent?

Ans. I should say two in each piston-rod.

Cross-int. 106. Do you mean the slots *o*? I find in the description of the patent that there are four of them, and four shown in the drawings. Is that so?

Ans. I consider that one above and one below are equivalent to one slot, and the other two form the other slot, these crossing at their centres.

Cross-int. 107. Does not the shaft pass through the longitudinal slot formed in the piston-rods, so that the motion of this piston is limited in this way?

Ans. In one case it passes through and in the other case it is not so represented.

Cross-int. 108. Do you find any adjustable stops for adjusting the stroke of the piston in this patent?

Ans. Not any adjustable stops; the crank-pins form the stops in this patent, as I understand it.

Cross-int. 109. With the knowledge of the construction of the valve described in this 1869 patent, and the experience you have in the construction and operation of this class of water meters to aid you, could you not make a meter like Exhibit 5 from the specification and drawings of patent 5806?

Ans. I think I should have to invent a little first.

Cross-int. 110. What parts, for instance?

Ans. A manner of introducing that valve under the crank-shaft, and

securing the crank-shaft in place. With a model I might be enabled to do it, but not from the drawings.

Cross-int. 111. You say in answer to int. 32 that you could not use the parts or combinations of parts which form the subject-
93 matter of the first and third claims of the reissue without using some other device with them, or words to that effect. Suppose you had a bob weight on a lever, or any other well-known mechanical device, for carrying the crank over the centres, such, for instance, as shown and described in the patent of J. Hartin of May 24, 1853, No. 9746, which you have set up in your answer, but failed to put in evidence (and which is now put in evidence by complainants, and marked Exhibit Hartin Patent, C. F. S., sp'l ex'r), could you not make an operative meter out of it?

Ans. That would be adding another device to the combination of the parts referred to, and with such addition it might make an operative meter.

Adjourned.

BOSTON, *Jan.* 29, 1877.

Direct examination resumed:

Int. 112. How does the motion of the valves in Exhibit 5 compare with the motion of the valves in your meter Exhibit 6; and what is the difference as to the motion of the pistons caused by this difference in the valves? Refer, if it will make your answere learer, to the valve and valve seat now shown you (which is put in evidence, and marked Exhibit B, C. F. S., special examiner).

(Objected to as leading.)

Ans. The motion of the valve in Exhibit 5 is such that the valve port to the piston operating should be closed while its crank is on its dead centre. It is gradually opened by the motion of the crank in making a revolution or part of a revolution equivalent to ninety degrees, at which point the port is wide open; it then gradually closes in making the next ninety degrees, and is closed when the crank reaches the other dead centre, consequently the valve port is wide open only when the crank is in a vertical position. In the case of the valve in Exhibit B the port is closed when the crank is on its dead centre, and gradually opens during the first forty-five degrees; it then remains open for the next ninety degrees of its revolution, and then gradually closes in making the next forty-five degrees of its revolution. The effect in Exhibit 5 is that the motion of the piston is gradually increasing from the commence-
94 ment until it reaches its half-stroke; it is then gradually decreasing during the remainder of its stroke, and the relation of the cranks to each other is such that as one crank nears its dead centre the other approaches the vertical position, and the crank nearing the dead centre is connected with the piston that is decreasing its speed, while at the same time the other crank is connected with the piston whose speed is increasing; the consequence is that the crank nearing its dead centre is forced against the wall of the slot by the accelerated action of the other piston and crank in proportion to the area in the ports. In the case of the other, the motion of the piston is uniform for ninety degrees of the revolution of the crank, and the ports open and close quicker in relation to the motions of the pistons.

Int. 113. Please explain more fully the purpose of the adjustment by means of the stops, and state whether the stops can be adjusted for more than one purpose or not, in the meter described in the original Ball and Fitts patent (Exhibit No. 1) and in Exhibit A; and also what

adjustment, if any, is made in practice to cause meters of this kind to register correctly.

Ans. As I understand this patent (Exhibit 1), the purpose of the stops is for stopping the piston when it reaches the end of its stroke, to allow the crank to pass its dead centre freely, and also to stop the motion of the piston at such a point as will just allow of this, and so that one piston will not compel the other to move while its valve port is closed; and I don't understand this stop to be for the purpose of determining the amount of water delivered after the meter is put together. In Exhibit A I do not think the stops can be adjusted to regulate the amount of water delivered, as the stops shown in this meter are of different construction from those in Exhibits 5 and 1, though this machine bears the same date of patent, Nov. 22, 1870; and in different meters of this construction that I have examined, I find the gear meshing into the pinion gear sometimes to contain fifty-eight, sometimes sixty, and other number of teeth, in that vicinity, and judge that to be the manner of adjusting as to measurement.

Cross-examination resumed:

Cross-int. 114. Is it not a fact that in the operation of meters like
95 Exhibit 5, while the speed of one piston is decreasing, the speed of the other piston is increasing in corresponding ratio, and as a consequence the valve rotates with a uniform speed?

Ans. In Exhibit 5 I think it is so, referring to the motions of the valve.

Cross-int. 115. How is it with the valve of your meter; does it revolve with uniform speed?

Ans. No; it does not.

Cross-int. 116. Does it revolve with an intermittent rotary motion; or how does it move?

Ans. Somewhat of an intermittent motion; that is, it is faster in one place than in another.

Cross-int. 117. Do you mean to say it moves a certain distance, then stops, and then moves on again?

Ans. It does not stop entirely at any point, but the motion is accelerated a little at the half-stroke of each piston.

HENRY A. DESPER.

Attest:

CHAS. F. SLEEPER,
Special Examiner.

Deposition of William E. Desper.

Direct examination by JAMES E. MAYNADIER, Esq., of counsel for defendants:

BOSTON, *Jan.* 29, 1877.

Int. 1. What is your name, and arey ou one of the defendants in this suit?

Ans. William E. Desper; I am.

Int. 2. How long have you manufactured meters, and what is your trade, and how long have you followed it?

Ans. About six years; I am a machinist; have followed the trade thirty-two years.

Int. 3. What experience have you had in working from drawings?

Ans. Various machines, parts of machines, such as steam-engines, machinists' tools in general.

Int. 4. Are you familiar with the reissue No. 5806, Complainants'
96 Exhibit No. 4? And if yea, state whether a mechanic skilled in the art of making water meters could manufacture a meter from the drawings and specification of that reissue; and explain fully the reason for any opinion you may express.

Ans. I am familiar with this reissue. In my judgment, he could not. The drawings are very much confused generally. Fig. 1 is a representation of Fig. 2, and is wrong. Fig. 2 is a representation of 1. In Fig. 1 the drawing shows the crank-shaft as passing through the connecting-rod, and the roll of the wrist-pin as not being in the slot *e*. The slot *e* is shown as closed, whereas it should be open at the ends. Fig. 2 is a plan. The crank-shaft *i*, as shown here, is represented as having no bearings; the valve *g* is not described with that clearness that a competent mechanic could construct the valve. It is not shown whether it is a conical valve or a disk; the number of ports are not designated. In Fig. 4, a skilled mechanic would be misled by that drawing; the cylinder head is represented as laying in cement and forming a part of the cylinder; this slot is also shown as being closed up at the ends, as I under stand it. In Fig. 2 there is something designed which he would be unable even to conjecture what it was. It appears to be something like a frame, something that lays over the valve; and on the whole, I do not think a competent mechanic would be able to construct a meter from these drawings and specifications.

Int. 5. Are you familiar with the Ball and Fitts patent of 1869? And if so, please answer preceding question, assuming that the skilled mechanic was familiar with the '69 patent.

Ans. I am familiar with this patent. With my knowledge of hydraulics and the mechanic arts, I could not, nor do I believe a competent mechanic could, construct such a meter without involving invention.

Int. 6. Are you familiar with the following patents, viz: No. 78551, dated June 2, 1868, to Sutherland; No. 55547, dated June 12, 1866, to Spencer and Meyer; No. 50651, dated Oct. 24, 1865, to Barden; the Ball and Fitts patent of 1869, and the Ericssou patent, No. 7689, dated Jan. 1, 1851? And if so, state what parts are in common between them and the Ball and Fitts reissue as exemplified in Exhibit 5.

Ans. I am familiar with them. J. Sutherland's meter bears this
97 resemblance: it has two cylinders, side by side, as the measuring vessels, that contain two double acting pistons that are connected by rods, having slots in the middle of these rods for the purpose of actuating a crank-shaft having two cranks, through which rotary motion is communicated to the shaft. In the Spencer and Meyer patent, two cylinders as measuring vessels, two pistons that are double-acting, the rods of which have oblong slots for the purpose of conveying rotary motion to the crank-shaft, that has two cranks.

(Noon recess.)

In J. S. Barden's patent I find this resemblance: two cylinders as the measuring vessels; four pistons, two cranks and two crank-shafts. In the Ball and Fitts, 1869, patent I find a very striking resemblance in many particulars. In this there are two cylinders, two double-acting pistons, having connecting rods with slots that operate the crank-shaft; a rotary valve which is represented in Fig. 4 in vertical section, showing the receiving and discharge ports. It is also shown in Figs. 1 and 5, by which it will be seen there are six ports, three of them for induction ports, and three for discharge ports. It appears to be the identical valve incorporated into Exhibit 5. It is conical in form, and connected

with it is a gear that rotates in relation to the crank-shaft as one to three. In the Ericsson patent, almost a complete embodiment of the elements in Exhibit 5. It has two cylinders, two double-acting pistons in which are slots that are of greater width than the diameter of the crank-pin, that at the end of each stroke the crank shall pass through a portion of its rotation without moving the pistons. It also has stops, the object of which is to stop the piston-rod, that it shall remain at rest while the crank is passing its dead centre, and thereby prevent one piston from compelling the other to move when its valve ports were closed. The stops are also for another purpose—to determine the length of the stroke of the piston, that it shall discharge the required amount of water. These stops, as I understand it, are adjustable by using washers of a different thickness. There is a double crank-shaft that operates the valves through eccentrics. All the devices that are common to both are identical and for the same purpose.

98 Int. 7. Compare your meter (Exhibit 6) with the meter described in the Ball and Fitts reissue No. 5806, and exemplified in Exhibit 5, and state what, if anything, you find in common between them which is not also found in one or more of the meters described in the prior patents referred to in the last question.

Ans. The parts common to both Exhibits 5 and 6 are two cylinders, two double-acting pistons, two connecting rods, adjustable stops, and a rotary valve. The piston-rods in both cases have slots. In Exhibit 5 the slots are narrow at their ends, having concavities at their middle. The slots in Exhibit 6 are the same width throughout their length.

I find all these devices in the aggregate of the patents before referred to, but not in any one of them.

Int. 8. What is the purpose of the stops in the meter described and shown in the original Ball and Fitts patent, Exhibit No. 1? What indication or suggestion is there in that patent, if any, that they have more than one purpose? And how are the meters adjusted as to the quantity of water discharged in practice? And state whether any other mode of adjustment is possible or not practically.

Ans. I read in the text, "The stops *o o* are for the purpose of stopping the pistons when they reach the end of their stroke." There is nothing in the specification that indicates they are for any other purpose. The adjustment is determined by a change of gears in the registering apparatus, by a greater or less number of teeth in the gears. In my judgment, it cannot be done in any other way without deranging the operation of the meter.

Int. 9. What interpolations, if any, do you find in the reissue? And state what is the best form of slot in the connecting rods, and best width of slots relating to the diameter of crank-pin, when the cylinders, pistons, piston-rods, crank-shaft, and valve are as in Exhibit 5.

(Counsel for complainants objects to the construction of the patent by the witness, it being the province of the court to construe letters patent, and not the defendant, who is sued for the infringement of said patent.)

Ans. In the detailed description in the specification, Exhibit 4, it is stated that "it will be seen, first, that we make the general width
99 of the slot *e* somewhat greater than the diameter of the wrist-pin *n*, and, secondly, that its width is still further enlarged on each side at or near its centre, as shown at *v*, being the points necessary to allow the crank to turn freely over after the piston has been stopped"; that is, it sets forth two kinds of a slot, a widened slot, and a slot having concavities, not but one kind of a slot being described in the original, and that so described is as follows: "It will be seen that the sides of the slot

are not parallel or straight, the slots being wider in the middle than at the ends"; also, in the first clause of the claim, it is, "slots formed as shown, with concavities to the right and left of centre," and any other slot than this described is an interpolation. The best form of the slot, in my judgment, is a slot having concavities at the centre, the ends just the size of the wrist-pins, or slightly in excess, so as not to bind. Such a slot conforms well to the construction of this Exhibit 5.

Int. 10. How many pistons are essential in your meter? Explain this fully. And how many in the Ball and Fitts meter, Exhibits A and 5, and why?

Ans. It is not essential to have but three in any meter, that is to say, one piston may be cut away like this. (Witness here introduces a piston, which is marked Exhibit Piston, C. F. S., special examiner.) The induction pipe in our meter entering at the bottom of the meter, the water passes up through the valve into the several ports that lead to the cylinders, one piston is cut away like this exhibit to allow the water to pass out of the meter, when the water is shut off from the meter. When in operation, the pressure of the water is against the other end of the piston, and the same result is obtained as if the other end was not cut away as shown. In the Ball and Fitts meter it is necessary there should be four, otherwise the water would pass through without measuring; the water entering at the top of the valve, the water would pass directly out, and the meter would be wholly inoperative, which shows they do not operate on the same principle.

(Question and answer objected to as immaterial.)

Adjourned.

100 BOSTON, *Jan.* 30, 1877.

Int. 11. What parts of the meter described in the Ball and Fitts reissue are not found in your meter, and what parts in your meter are not found in the Ball and Fitts reissue?

Ans. In the reissued patent, Ball and Fitts, and as exemplified in Exhibit 5, a common shaft having two cranks, one on each end. I also find a compound device of gears that rotate in relation to one another as one to three, being a necessary arrangement in controlling the ports, opening and closing at the right time to operate the pistons. I also find adjusting stops described in the following language: "The adjustment of the length of a stroke of the pistons, in order to discharge a given quantity of water, is effected by interposing a greater or less number of washers, *w*, between the pistons and the adjusting stops, as indicated by the drawings; or washers of different thickness may be used. When the proper thickness is obtained the stops are then screwed up tight." By this arrangement it will be seen that the length of the stroke of the piston is determined by the thickness of the washer or washers, governing and determining where the screw shall be when it abuts against the cylinder head. In our meter, a single crank attached to the valve, the wrist-pin of which passes entirely through two slots that cross each other at their centre. I also find two cylinders that cross each other on the same plane; also screws for stops in the cylinder heads, without any combination of washers; a valve having but two ports, or two slots, that communicate to the several cylinders.

Int. 12. Is Exhibit 5 now of any practical use as a water meter? If not, why not? And explain fully what has caused the increase in width of the slots and decrease in the diameter of the wrist-pins.

Ans. In my judgment, this is not a practical operating meter. Evidently it has been worn by use until the slots in the connecting rods

have worn to that extent that it will not measure water accurately. The slots and wrist-pins appear to show the greater wear, and in consequence of this wear the slots will not act on the crank at such time as will open the port to the other side of the piston, as it would when it was originally put into use. The cause of this wear is in consequence
101 of the sluggish motion of the valve in relation to the pistons; one piston being in continual conflict with the other in its operation, one piston forces the water to move by the other; and I have no doubt that I can draw one hundred gallons of water per day without this meter registering a particle.

Int. 13. What in practice is the manner of adjusting as to measurement in the Ball and Fitts meters, such as are in controversy?

Ans. In practice, by making a change of gears in the indicators.

Int. 14. Are there any stops in Exhibit A? If so, please describe them.

(Objected to as immaterial.)

Ans. There are stops, but not adjustable stops, except as by filing off lugs that are attached to or cast on to the connecting rods.

Int. 15. Where are the stops? Point them out clearly to the magistrate.

(Same objection.)

Ans. The stops are cast on the centre of the cylinders, and the pistons have lugs on each side of their centres, which come in contact with the stops.

Int. 16. How does the motion of the valves in Exhibit 5 compare with the motion of the valves in your meter, Exhibit 6? And what is the difference as to the motion of the pistons caused by this difference in the valves? Refer, if it will make your answer clearer, to the valve and valve-seat, Exhibit B.

Ans. In Exhibit 6, by the direct action of the pistons through the slots in the rod, one revolution of the valve is made by a double stroke of the piston, and in consequence of this accelerated motion of the valve B in relation to the pistons, the port will not remain closed so long while the crank is on its dead centre, and therefore is not liable to that conflict between the two pistons. In Exhibit 5, it requires the crank-wrist to pass ninety degrees to close the valve-port; in Exhibit 6 it requires forty-five degrees. The motion of the crank-wrist in Exhibit 6 is more clearly shown in this exhibit which I now produce (marked Exhibit D, C. F. S., special examiner).

(Counsel for complainants objects to Exhibit D, just introduced, for the reason that it does not appear to be constructed in all respects like Exhibit 6.)

102 Cross-examination by ANDREW MCCALLUM, Esq., of counsel for complainants:

Cross-int. 17. In answer to ints. 4 and 5, and after stating that you were familiar with the meters described, the reissued patent 5806, and the Ball and Fitts 1869 patent, you say that with such knowledge and with your knowledge of hydraulics and the mechanic arts, you could not construct the Ball and Fitts meter from said patents "without involving invention." Please describe what you would have to invent before you could construct meters like Exhibit 5, that is not shown and described in these patents to Ball and Fitts.

Ans. The method of changing that valve from the patent of 1869, as arranged in Exhibit 5, there being nothing shown in the specification or drawings by which the crank-shaft would have any bearings, the sleeve

of the crank-shaft not being shown at all in the specifications; and it would be more than skill and judgment in a mechanic to arrange some contrivance by which this change could be made.

Cross-int. 18. The valves are the same in both, are they not?

Ans. They are.

Cross-int. 19. Then you think the taking of the valve described in the '69 patent and placing it in the position shown in the reissued patent 5806 involves invention. Is that your opinion?

Ans. The drawings in the reissued patent do not show that it was the valve of 1869, as I understand it. It might be a disk or a straight cylindrical valve. It does not show the number of ports that exist in the '69 patent.

Cross-int. 20. The question is this: Supposing the valve to be identical in both cases, would there be any invention in taking the valve described in the '69 patent and putting it in the position in the meter shown and described in the reissued patent?

(Objected to as immaterial.)

Ans. Not necessarily to place the valve there.

Cross-int. 21. Please look again at the Sutherland patent, and state what kind of valves you find therein shown and described, how many valves there are, and how many sets of valve-ports.

Ans. Two slide-valves and two sets of valve-ports.

103 Cross-int. 22. How are the valves operated?

Ans. By levers coming in contact with the ends of the yokes or slots.

Cross-int. 23. Has the crank-shaft in that machine anything to do with the operation of the valves?

A. No, not directly; it does indirectly.

Cross-int. 24. How?

Ans. The two slots being connected by wrist-pins, keeps the pistons in that relation to each other that the valves will be operated in time to move the pistons.

Cross-int. 25. Are there not four double-acting pistons in said patent?

Ans. On examining it closely, I should say there were.

Cross-int. 26. What kind of valves are there in the Spencer and Meyer patent, and how many of them?

Ans. Two slide-valves.

Cross-int. 27. Are they not operated by eccentrics on the shaft, the rotary motion of the shaft being thereby converted into reciprocating motion of the valves, as in an ordinary steam-engine?

Ans. Yes.

Cross-int. 28. What description of valves and how many of them are found in the Barden patent?

Ans. Two slide-valves.

Cross-int. 29. Are there any slots or piston-rods with slots in them shown in that patent?

Ans. There are no piston rods showing slots in them, nor are there any stops, designated as such.

Cross-int. 30. You say, in referring to the Ericsson patent, that you understand the stops of that meter are adjustable by using washers of different thicknesses. Is there anything in the specification which says that the stops are adjustable by using washers of different thickness? If so, quote the language in which you find it.

Ans. I think the language in the specification implies that they may be adjusted by washers of a different thickness, and refer to this clause: "My invention in the above apparatus also consists in determining the

range of motion of the piston by means of stops at each end, con
104 nected with the cylinders and pistons, instead of doing this by the cranks, by reason of which I am enabled to measure the fluid passing through with the utmost accuracy, a result which could not be obtained if the motions of the pistons were determined by the crank; for the least wear of either the crank-pins or the journals of the shafts, or the boxes in which these work, or the slightest change in the position of the cylinders relatively to the parts with which the pistons are connected, occasioned by strain or wear, would of necessity vary the amount of water discharged at each stroke." The adjective "adjustable" is not used in the specification, but if the range of the piston is determined by this washer or washers, that motion of the piston determines the amount of water discharged by the stroke of the piston to that degree of accuracy to which he makes reference; consequently, if the range of the piston was too great, he must interpose a washer or washers of greater thickness to make the stroke of the piston less, and the washer or washers is the stop.

Cross-int. 31. The question does not call for an argument to show how you convince yourself that the stops are adjustable. The question is, Does the specification describe the stops as adjustable by using washers of different thickness or more than one washer?

Ans. It does not describe more than one washer, but it implies it.

Cross int. 32. Does this specification describe any means of altering or varying the stroke of the piston after it is once determined?

Ans. It does not.

(Noon recess.)

Cross-int. 33. What description of valve and how many of them are described and shown in the Ericsson patent?

Ans. Two slide-valves.

Cross-int. 34. How do you adjust the length of stroke of piston in your meters like Exhibit 6?

Ans. By a screw in the cylinder heads.

Cross-int. 35. Did you ever have any meters tested by the testing apparatus belonging to the city of Worcester, in order to ascertain whether they measured a given quantity of water correctly?

Ans. Yes.

105 Cross-int. 36. Did you ever find any that did not measure correctly after being subject to this test?

Ans. I do not know of any.

Cross int. 37. Did you never, after such a test, adjust the length of the stroke of the pistons so as to make them measure the exact quantity of water desired to be measured, by adjusting the position of the stops inserted through the cylinder-heads of your meter?

Ans. I do not know of any such instance; can't call to mind any such; don't think it was possible, to the best of my recollection, that is.

Cross-int. 38. Is it not a fact that, by means of these screws in your meter, the stroke of the piston, and consequent amount of water discharged, can be varied to a certain degree without otherwise affecting the operation of the meter?

Ans. Yes, in a small degree.

Cross-int. 39. Say from one to two per cent. in the amount of water discharged?

Ans. Yes.

Cross-int. 40. Is it not a fact that you were required by the water committee of the city of Worcester to cut off the heads of the screws which projected outside the cylinders of your meter, for the reason that

the quantity of water discharged could be varied at pleasure by adjusting these screws in this way? I refer to the meters sold by you to the city of Worcester.

Ans. No.

Cross-int. 41. Please look at the drawings of the orignal patent (Exhibit 1), and state whether or not you see by said drawings that the general width of the slot in the piston-rod is somewhat greater than the diameter of the wrist-pin.

Ans. In Fig. 2 of the drawings, it shows the width of the slot to be somewhat greater than the diameter of the wrist-pin; but in Fig. 1, I find it to be just the size of the slot, or the slot slightly in excess of the wrist-pin. The difference in the size of the slot and the wrist-pin is so slight that it is hardly percep ible, as shown in Fig. 1 at the bottom of the drawing. The width of the slot at the top of the drawing is not shown, being covered by another device in the drawing.

106 Cross-int. 42. Does the crank-pin last referred to show in the drawing as filling the slot? Is there not a space between it and the wall of the slot that you do see?

Ans. There is, at the left-hand side. The other side not being shown, I do not know how wide the slot is.

Cross-int. 43. Is it the same in Fig. 2 of the reissue drawings. in this respect?

Ans. In the reissued patent, at the top of the drawing, so much of it as can be seen, indicates that the slot is of a greater width than the diameter of the wrist-pin.

Cross-int. 44. Question repeated, with the explanation that the question calls for a comparison of the two drawings, and a statement from the witness as to whether or not they are the same as regards the comparative width of the slot and the diameter of the crank-pin.

Ans. So far as I can see, they are the same, not being able to see one side of the slot in either case.

Cross-int. 45. Are they the same in regard to the width of the space between the crank-pin and the wall of the slot that you do see?

Ans. As near as I can measure or see by my eye, they are the same.

Cross-int. 46. If the wrist-pin does fill the slot, would there be any space between it and the wall of the slot?

Ans. There would not.

Cross-int. 47. Then you can see that in both the original and reissued patent drawings the slot is of a width somewhat greater than the diameter of the wrist-pin, can you not?

Ans. I can in one place, and in another place I cannot, the drawings not being alike in the original and reissued patent.

Cross-int. 48. Can you see from these drawings whether or not the width of the slot is still further enlarged on each side at or near its centre?

Ans. In the original drawing, Fig. 2, it is shown as being enlarged at or near the centre, and in the reissued patent, Fig. 1, the slot is shown to be enlarged at or near its centre, while in Fig. 4 of the reissued patent it is not shown to be enlarged.

107 Cross-int. 49. Fig. 4 is described as a sectional elevation along the line of the machine cut off in Fig. 1. Would not that view show an elevation of the back of the rod, and not of the inner or slotted side of the same?

Ans. It would show a sectional elevation cut off from Fig. 1, but it does not show that the connection rod was cut off, as it appears to me,

the drawing being so defective. It does show the back side of the piston-rod.

Cross-int. 50. You say in answer to int. 12 that you can draw one hundred gallons of water per day through Exhibit 5 without that meter registering a particle. Do you mean to be understood as saying that this Exhibit 5 is so worn out as to be inoperative?

Ans. No, not to a certain extent; but it would not register water accurately.

Cross-int. 51. You have said that it is not a practically operating meter, in answer to the same interrogatory (12). Do you still adhere to that opinion?

Ans. I do, where accuracy is required.

Cross-int. 52. Do you attribute its defects to the wearing of the walls of the slots?

Ans. Principally. It is otherwise worn.

Cross-int. 53. In answer to int. 13 you say that in practice the adjustment of the Ball and Fitts meter is effected by a change of gears in the indicator. Do you speak from your own knowledge of the adjustment of these meters? Did you ever adjust any of them?

Ans. No, sir; I did not.

WILLIAM E. DESPER.

Attest:

CHAS. F. SLEEPER,
Special Examiner.

108 *Exhibit Ball and Fitts 1869 patent.*

Letters patent of the United States, No. 92691, granted Phinehas Ball and Benaiah Fitts, July 20, 1869. Improvement in fluid meters.

The schedule referred to in these letters patent, and making part of the same.

To whom it may concern:

Be it known that we, Phinehas Ball and Benaiah Fitts, of the city and county of Worcester, and State of Massachusetts, have invented a new and useful improvement in fluid meters; and we do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawing, making a part of this specification, in which—

Figure 1 represents a plan-view of the meter, with a portion of the shell or cap removed, to show the valve.

Figure 2 represents the face of the valve-seat, showing the location of the ports.

Figure 3 represents the face of a valve-seat, with the ports located differently from Fig. 2, but producing the same result.

Figure 4 represents a vertical section of the valve, inverted, showing the receiving and discharge ports.

Figure 5 represents the face of a valve, showing the location of the ports, or the manner of dividing up the valve.

Figures 6 and 7 represent the device used for securing a tight joint where the shaft passes through a bearing.

Figure 8 represents a portion of the piston-rods, showing slots, in which crank-pins move, by which motion is communicated to the crank-shaft, similar to the "crank-motion."

The same letters refer to the same parts in all.

It will be seen that this meter, in its movements, is similar to a double-cylinder engine, the cylinders being measuring cylinders, charging and discharging at both ends of each cylinder at every revolution of the crank-shaft, the valve and the means of operating the valve and the general arrangement being peculiar and novel.

The construction is as follows:

A *a*, B *b*, are two measuring-cylinders, in which are pistons C *c*, D *d*, the piston being shown by dotted lines, and in two positions.

E is a revolving shaft.

F *f* are rods, connecting pistons B to *b*, and C to *c*.

In these rods are slots, through which the shaft E passes; also crank-pins, shown in Fig. 8.

On the shaft there are two disks, G G.

In each of these disks there are two pins (crank-pins), placed sixty degrees from each other, and projecting through rods F *f* in slots *o o o o*.

The slots in F *f* are so formed that when the rods pass back and forth the pins move freely through the slots *o o o o*, giving to the shaft a rotating motion, similar to the crank-motion.

H is a conical valve, constructed with ports, passages, etc., as shown in Figs. 1, 4 and 5.

It will be seen by Fig. 5 that there are six ports, R R R, and S S S, and six intervening spaces, the spaces being as large or a little larger than the ports.

R R R are receiving-ports, receiving the water through the base of the cone.

S S S are discharge-ports, discharging the water through a tube at the apex of the cone. (See Fig. 4.)

Around the base of the cone is a gear, *s* (see Fig. 1), by which motion is given to the valve by a gear on the crank-shaft E, the crank-shaft performing three revolutions to the valve one.

I is the valve-seat, to which the valve H is fitted, and through which are ports *w w*, *v v*, opening into passages *x x x x* to the cylinders.

The ports are located in the valve-seat, as shown in Figs. 1 and 2, or may be, and produce the same result as shown in Fig. 3, *w w* opening to the opposite ends of one cylinder, *v v* opening to the opposite ends of the other.

At L, Fig. 1, the shaft E passes through a bearing, to keep this water-tight, as it may be desirable to do. It is constructed as shown in Figs. 6 and 7, Fig. 6 being an elevation, Fig. 7 a plan view.

K is a portion of the frame in which the bearing is formed, being cast in shell-form, as is usual for lining with soft metal, with the space for the metal extending outward to the cap *n*, as shown by the dotted lines.

m is a cap, fitted to the shaft. The shaft E and cap *m* are put in position. Then the space in frame K, around shaft E and cap *m*, is filled with soft metal or other substance, in the usual manner of filling soft-metal bearings. The frame K, cap *m*, and soft metal being reduced to one level, cap *n* may be packed on with rubber or other substance, in the usual manner of packing flat surfaces.

If the bearing wears, the set screw *t* may be turned to force the cap *m* down, and more packing may be put between caps *m* and *n*, making it tight again.

p is the receiving-pipe.

y is the discharge-pipe.

The operation is as follows:

The valve and cranks being set so that when ports *v v* are closed piston D *d* should be at one end of the cylinder, ports *w w* will then be open, one through the receiving-port R of the valve, the other through the discharge-port S, and piston C *c* should be at the centre of the cylinder A *a*. The water then flows into cylinder *a* through passage x^2, and out of it through x^1, the pressure of the water moving the piston, and with it the valve, in the direction of the arrow, opening ports S S, and allowing the water to flow into cylinder B through x^3, and out of *b* through x^4.

By the time piston C gets to the end of the cylinder A, the valve will have closed ports *w w*; and as the valve is moved on by piston D *d*, ports *w w* commence opening to the opposite ports of the valve, allowing the water to flow in at x^1 and out at x^2. Also, when piston D *d* reaches the end of the cylinder, the valve changes the flow of water to the other end of the piston, and so on, giving to the valve a constant rotating motion; and as one or more ports are always open, and never more nor less than equivalent to one port, whatever the position of the valve, we always have a constant, steady flow of water.

111 It will be seen that by the peculiar form of the slots *o o o o*, in combination with the "crank-pins," the pistons have a velocity, as compared with the valve, just in proportion to the openings of the ports that charge and discharge the cylinder; that is, when the ports commence to open, the pistons are at the end of the cylinder, and move very slow; when the ports are half open, the piston moves much faster; and when the port is wide open, it moves twice as fast as when half open, and so on through the whole stroke.

It will also be seen that though the valve divides the measured from the unmeasured fluid, there is always equivalent to one pair of ports open; there consequently can be but little pressure on the valve; that is, the valve is nearly balanced.

By knowing the amount the cylinder discharges, a register may be constructed and attached to the gear or any convenient part.

Thus having set forth our invention,

What we claim as new, and desire to secure by letters patent, is—

1. The rotating valve H, with its charge and discharge ports and gear, substantially as described.

2. The valve-bevel, with its ports *w w*, *v v*, and passages x^1 x^2 x^3 x^4, in combination with the valve H, and operating substantially as set forth and described.

3. The cap *m*, secured by soft metal and other packing, and by cap *n*, and set screw *t*, all combined and arranged and operating as set forth.

4. The disks G G, having projecting pins, in combination with the slotted connecting-rods F *f*, the slots *o o o o* being so formed as to give to the piston a varying velocity, in proportion to the opening through the ports, substantially as described.

5. In combination with the cylinders and their pistons, piston-rods and disks, substantially as shown, the rotary shaft so constructed as to receive its motion from the piston-rods, communicating it to the valve, substantially as shown and described.

PHINEHAS BALL.
BENAIAH FITTS.

Witnesses:
GEO. W. WHEELER.
M. G. B. WHEELER.

112 *Exhibit Ericsson patent.*

Letters patent of the United Seates No. 7869, granted John Ericsson, Jan. 1, 1851.

Specification.

To all to whom these presents shall come:

Be it known that I, John Ericsson, of the city, county and State of New York, have invented certain new and useful improvements in the meter for measuring water and other fluids, and that the following is a full, clear, and exact description of the principle or character which distinguishes my invention from all other things before known, and of the method of making, constructing and using the same, reference being had to the accompanying drawings making part of this specification, in which Fig. 1 is a plan, with the enclosing casing and one of the valves removed the better to exhibit the internal arrangement; Figs. 2 and 3, vertical sections taken at the lines A *a* and B *b* of Fig. 2; Fig. 4, a plan, and Figs. 5 and 6, vertical sections taken at the lines C *c* and D *d* of Fig 4, of a modification of my improved instrument, intended for the measurement of large quantities of fluid.

In this instrument I employ the hydrostatic or mechanical pressure of the fluid to be measured in its course from the source to the place of delivery to operate the mechanism which determines and indicates the quantity of fluid which passes through, whether the instrument be applied to the measuring of the quantity of water which passes through pipes or conductors, such as the main and branch pipes for supplying cities, or for ascertaining the quantity of water fed into a steam boiler in any given time, or for measuring the quantity of fluid put into casks or tanks by means of pumps, siphons or other devices, or to the measuring of liquids, for any other purpose.

But the leading object of my invention is to measure the quantity of water which passes through the main and branch pipes for
113 the supply of cities. It is therefore important that the said instrument should possess the combined properties of cheapness of construction, accuracy of measurement, simplicity, compactness, and durability.

To these ends the principle or character which distinguishes my invention from all other things before known in an instrument having two cylinders provided with pistons connected with cranks at right angles or such other angles as will enable the pistons alternately to act on the crank-shaft to rotate it, consists in connecting the two pistons with their cranks so that while the shaft is impelled by one piston the other shall remain at rest at the end of each stroke, until the shifting of the valves is completed, for the purpose of insuring the accurate measurement of the fluid passing through and acting as the motive force.

My invention in the above apparatus also consists in determining the range of motion of the pistons by means of stops at each end connected with the cylinders and pistons, instead of doing this by the cranks, by reason of which I am enabled to measure the fluid passing through with the utmost accuracy, a result which could not be obtained if the motions of the pistons were determined by the crank, for the least wear of either the crank-pin, or the journals of the shaft, or the boxes in which these work, or the slightest change in the position of the cylinders relatively to the parts with which the pistons are connected, occasioned by strain or

wear, would of necessity vary the amount of water discharged at each stroke.

My invention in the before-mentioned apparatus also consists in attaching to the instrument an outer casing, through which the fluid to be measured passes and from which it enters the cylinders, which casing encloses the valves and valve gear, as also the other moving parts and the upper ends of the cylinders, that the various moving parts may work in the fluid to be lubricated thereby, whilst at the same time the various joints are protected by being pressed with a nearly equal pressure on all sides by the fluid, and also avoiding the use of packing-boxes for the sliding parts of the mechanism.

In Figs. 1, 2, and 3 of the accompanying drawing, (*a*) represents the base of the instrument, the upper surface of which is to be properly adapted to the reception of the other parts, to be hereinafter de-
114 scribed. This base is found with two recesses (*b*, *b*), which constitute the lower halves of two cylinders in which the pistons are to work, and each recess is formed with a port (*c*) which is alternately an induction and eduction port. Around each of these recesses the base is with bolt holes (*d*) to admit of securing the upper part (*e*) of the cylinders formed with projecting flanges (*f*), through which the securing bolts pass. Between the parts (*e*, *e*) and the base is interposed suitable packing (*g*), to form when bolted together water-tight joints. This packing around the periphery of the cylinders constitutes the packing of the pistons, and it is formed for each cylinder of a flat ring of metal (*h*), with two rings of leather (*i*, *i*), one above and the other below, whose inner edges are turned at right angles to fit the cylindrical surface of the pistons. The parts (*e*) of the cylinders are formed each with a port (*j*), which is alternately an induction and eduction port. And they are also each provided with a water way (*k*), which forms the continuation of the port (*c*) of the lower part (*b*) of the cylinders. Where the ports (*j*) and (*k*) issue out, the surfaces are properly planished to form seats for valves (*l*, *l*) such as are used in high-pressure steam engines, and between the two ports (*j*, *k* and *j*, *k*) there are eduction ports (*m*, *m*), which, as indicated by dotted lines, communicate with an eduction pipe (*n*), to which may be coupled a pipe leading to any desired receptacle. In fig. 1 one of the valves (*l*) is omitted to represent the three ports.

Referring to Fig. 2, the piston (*p*) is made cylindrical on its outer periphery and fitted to slide within the leather packing rings (*i*, *i*) before described, which, being forced by the pressure of the water against the periphery of the piston, not only make the joint water-tight, but at the same time wipe off all the water to ensure the accurate measurement of water at each operation. The rod (*q*) of the piston passes through a hole in the top (*e*) of the cylinder, which is surrounded with India-rubber packing (*r*), confined by a cap plate (*s*), to prevent leakage. The upper end of the piston rod is formed with a yoke (*t*) having a horizontal slot (*u*), which plays on a crank pin (*v*) on one end of a horizontal shaft (*w*), which shaft has its bearing in boxes (*x*, *x*) attached to the top of the cylinders The diameter of the crank pin is less than the capacity of the slot, so that at the end of each stroke the crank shall pass
115 through a portion of its rotation without moving the piston. The extent of this independent motion is indicated by a triangle drawn in red lines. The range of motion of the piston is determined in the upward stroke by the contact of a washer (*y*) with the under face of the cylinder top, and in the downward stroke by the contact of the yoke (*t*) and the collar (*z*) of the cap plate (*s*). In this way the motions of the piston are exactly determined, this being essential to the accurate meas-

urement of water. The crank shaft carries two eccentrics (a' a'), embraced each by a yoke (b') jointed to its appropriate slide valve (l). The two crank pins on the shaft are at right angles, so that when one passes the dead point the other will be at the full length of its leverage, that the two pistons may act in succession.

Instead of constructing the pistons and connecting them with the crank pins as above described and represented in Fig. 2, I contemplate sometimes adopting the arrangement represented in Fig. 3, where it will be seen that the piston rod (q) is of a much greater diameter, and hollow at the upper end to receive one end of a connecting rod (e') joined therein at (d'), and instead of the horizontal slot in the yoke to form the connection with the crank pin (v), the upper end of the connecting rod has a hole (e') so elongated as, at the end of the up and the down stroke, to permit the crank shaft to have an independent motion, as in the first example. The range of motion of the piston is regulated (in this arrangement) in the downward stroke by a projection (f') at the bottom of the cylinder, and in the upward stroke by a shoulder (g') on the piston rod which comes in contact with the collar (z) of the cap plate (s), which in this arrangement is inverted, the cap plate being made in two parts to secure the packing (r). The whole apparatus is inclosed by a casing (h'), secured, with packing interposed, to the base by screw bolts which pass through appropriate flanches in the casing, and through holes (v) in the base (a).

On the crank shaft there is another eccentric (j') embraced by a fork (k') on one end of an arm (l') attached to a spindle (m'), which passes through a hole in the outer casing and is there packed with India-rubber (n'), confined by a cap (o'). The spindle (m') is connected with
116 any registering apparatus that will indicate the number of vibrations which the fork receives from the eccentric on the crank shaft.

The water is introduced into the inside of the casing through an induction pipe (p), which may be coupled with a pipe leading from any place desired.

As the water enters under the pressure of a head and fills up the casing, it passes through the open port (j') of one of the cylinders and forces down the piston, and as the opening of the port (j') by the valve opens the connection between the exhaust port (m) and the other port (k), the downward motion of the piston expels the water from below the piston. The motion of the piston and the course of the water under this state of things is indicated in Fig. 3 by arrows; and the position of the parts in the other cylinder is represented in Fig. 2, where it will be seen that the piston is at the end of the down stroke. For the accurate measurement of the fluid it is necessary, after the piston has completed its stroke, that it should remain at rest until the valve shall have been shifted so as to connect the port through which the water entered the cylinder with the exhaust port and to open the other port, that the induction water may enter below the piston to force it up and thereby expel the water which has been measured above it. The motion of the valve to effect this change is obtained from the crank shaft, which is then impelled, during the repose of one piston, by the descending motion of the other piston, the play given to the connection of each piston with the crank pin admitting of the rest of one piston at the end of each stroke while the crank shaft is continued in motion by the other piston. It will be obvious that the same result will be produced by the up motion of the two pistons, the two alternately impelling the crank, which in

consequence continues to rotate and to shift the valves alternately while the pistons are alternately at rest.

By reason of the shifting of the valves whilst the piston is in a state of rest the quantity of water introduced and expelled from the cylinder at each stroke must be accurately measured.

It will be seen from the foregoing that all the moving parts work in water, and that the valves are nearly *in equilibrio*, as the pistons have only to carry the friction of the moving parts; hence there will be very little wear and very little liability to derangement.

117 The mode of making the packing for the pistons, by means of rings of leather, is similar to the mode long since practised in packing the pistons of pumps for impelling fluids; but when the action is reversed and the piston impelled by the fluid—if the packing-rings be attached to the piston as heretofore—the edge of the leather ring is pressed against the cylinder, so that the motion of the piston tends to tear the leather, particularly at the angle; and to avoid this injurious tendency, which would be a serious defect in an instrument of this kind, I reverse the arrangement and attach the packing-rings to the cylinder and place the pistons within them.

In the modification represented in Figs. 4, 5, and 6, the two cylindrs (a^2, a^2) are in the same line with the dividing space (b), separated from them by heads (c^2 c^2), through which the piston-rods (d^2, d^2) pass, with appropriate packing. The pistons are formed each of a disk (e), properly secured to a piston-rod, and the periphery is packed by means of two leather rings (f^2,f^2). The flat part of these leather rings is secured to the disk by metal rings (g^2, g^2), bolted through, and the cylindrical part bearing against the inner periphery of the cylinder.

The two cylinders are formed each with two parts (h^2 h^2), one at each end, governed by a slide valve (i^2), the motion of which alternately connects one of them with the exhaust port (j^2), the two exhaust ports leading to the eduction passage (k^2).

The two valves are operated by eccentrics on the crank-shaft (l^2), as in the first example before described, and the crank-shaft with the two crank-pins (m^2, m^2) receives motion alternately from the two pistons by the interposition of two rock shafts (n^2 n^2), connecting rods from the rockers extending up to the crank-pins, as indicated by dotted lines. The connection of the connecting-rods with the crank-pins is to be made as represented in Fig. 3.

The upper part of the instrument is inclosed by a casing (o^2), provided with an induction-passage.

In this last-described modification I do not make use of the reversed arrangement of the leather packing-rings, as described in connection with the first and second arrangements, as my improved mode of packing, for convenient attachment, requires the cylinders to be made each in two parts to admit of inserting the packing-rings.

118 I have herein described various modes of applying the principle of my invention, but I wish it to be distinctly understood that I do not limit myself to these, as the principle of my invention may be susceptible of other modifications.

The advantages of my improved instrument are the great accuracy with which fluids can be measured by reason of determining the stroke of the pistons independently of the cranks by means of stops connected with the cylinders and pistons, and of the completion of the motions of the valves whilst the pistons are at rest at the end of each stroke, and the durability of the moving parts and joints which have little or no tendency to wear or get out of order, or to leak, by reason of enclos-

ing them in an outer casing through which the fluid to be measured passes; for the moving parts are thus constantly kept in a lubricated state, the valve-rods are not required, as in steam-engines, to pass through stuffing-boxes, and the packed joints, instead of being exposed to an outward pressure only, are pressed on all sides by equal or nearly equal forces. The mode of making the packing for the pistons not only renders it less liable to wear and tear, but insures at all times a tight joint, and has the effect, by wiping off the surface of the pistons at each stroke, to render the measuring of the water more accurate. And finally it will be seen that by reason of my improvements I am enabled to employ slide valves to advantage, for the reason that as the only resistance to the motion of the pistons is the working of the valves and the friction of the moving parts which, working at all times in the fluid, will be balanced, it follows that the pressure of the issuing fluid against the under face of the valves will be nearly equal to the pressure of the entering fluid on their upper surface, thus keeping them nearly in a state of equilibrium and working with very little friction.

What I claim as my invention, and desire to secure by letters patent, is connecting the two pistons with the two cranks of a crank-shaft, in manner substantially as described, so that at the end of each stroke of either of the pistons it shall remain at rest while the crank-shaft is being impelled by the other piston, so that the valves shall be shifted whilst the piston is at rest, for the purpose substantially as described.

I also claim in an instrument for the purpose herein specified,
119 determining the range of motion of the pistons by means of stops connected with the cylinders and the pistons, substantially as described, in combination with the connection of the pistons with the crank or cranks, by means of a joint having sufficient play to permit the pistons alternately to remain at rest while the crank-shaft continues to rotate substantially as described.

I also claim enclosing all the moving parts of an instrument, substantially such as above described, in the surrounding casing through which the water or other fluid passes to be measured, constructed and operating in the manner and for the purpose substantially as described.

J. ERICSSON.

Witnesses:
CAUS'N BROWNE.
ALEX'R PORTER BROWNE.

Ex'd H. R.

Exhibit Desper Patent.

Letters patent of the United States, No. 144747, granted Henry A. Desper, Nov. 18, 1873. Improvement in fluid-meters.

To all whom it may concern:

Be it known that I, Henry A. Desper, of Worcester, in the county of Worcester and State of Massachusetts, have invented a new and valuable improvement in fluid-meters; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawings making a part of this specification, and to the letters and figures of reference marked thereon.

Fig. 1 of the drawings is a representation of a horizontal section of my fluid meter. Fig. 2 is a vertical transverse section of same. Figs. 3, 4, 5, 6, 7, and 8 are details of same.

120 The object of this invention is to employ four cylinders, which radiate from a common centre, and in which four pistons reciprocate, that are connected together in pairs and arranged in the same plane; also, to connect the two right-angular piston-rods of the four pistons directly to a rotating inlet and outlet valve by means of a crank, the wrist-pin of which plays in slots made transversely across the connecting rods.

The body of the meter consists of four cylinders, A^1 A^2 A^3 A^4, which radiate from a common centre, and form four right angles. These cylinders are all in the same plane, and through the centre of each one of the heads an adjusting-screw, *k*, is tapped, as shown in Figs. 1 and 2. Inside of the cylinder A^1 is fitted a piston B^1, which is connected, by means of a broad open rod, C, to a piston, B^3, working inside of the cylinder A^3; and inside of the cylinder A^2 is fitted a piston, B^2, which is connected, by a corresponding rod, C, to a piston, B^4, working inside of the cylinder A^4. It will thus be seen that there are four pistons, which are connected together in pairs by two rods arranged at right angles to each other. The axes of the pistons are all in the same plane, and the piston-rods C C′ are halved together, so that they cross each other above and below said plane without interference. This is represented in Fig. 2, and the construction of the rods is more clearly represented by Fig. 4, wherein it will be seen that one longitudinal half of each rod is cut away. The connecting rods have slots *s* made transversely through them at the middle of their length, through which slots passes freely the wrist-pin H of a crank, F. This crank F is keyed on the upper solid stem *d* of a cylindrical valve, D, and when the meter is in operation the alternate reciprocating movement given the pistons will cause the transverse slots *s* through the connecting-rods C C′ to communicate directly a regular rotary motion to the valve D. A corresponding rotary motion is also communicated to a stem, I, which passes water-tight through a cap, N, and whose axis of motion is concentric to the axis of the valve D, as shown in Fig. 2. The lower end of the stem I has a crank, I′, on it, through the end of which the wrist-pin H passes; consequently the rotary motion communicated to the stem I is received directly from the connecting-rods C C′. The stem I is packed at *m*, and is

121 held up to its seat by means of a spring, *d*, which is applied in a recess made into the cap N. (Shown in Fig. 2.) The stem I has a spur wheel, *e*, keyed on its upper end, which actuates a train of wheels that move the registering hand or hands. The registering mechanism may be constructed in any well-known manner. The valve D is cylindrical, and is located at the bottom of the cylinders at the intersection of four water ways, E^1 E^2 E^3 E^4. (Shown in Fig. 5.) Two slots are made horizontally across the valve D, on opposite sides of its axis, which have two cut-offs, J J, for the said water ways. One of the slots *i′* communicates at certain times with an outlet chamber, *b*, through a nearly semicircular passage, *c*; and the other slot *i* communicates with the water ways which lead into and from the cylinders, and receives the supply of water from a nozzle, L, through a hollow stem, *a*. The valve D is held down in its place upon the walls of the inlet-nozzle passage L by means of the cap G, through which the solid stem *d* of the valve passes, as shown in Fig. 2.

The water enters through the nozzle L, and passes up through the

centre of the valve at *a* on one side of the partition therein; thence out through the slot *i*, through the water way E^1, and into the outer end of the cylinder A^1, thereby driving the piston B^1 and the opposite piston B^3 toward the outer end of the cylinder A^3, and forcing water out of this cylinder through passage E^3 into the opposite side of valve D, and thence out of the nozzle O through passages *i* and *c*. The drawing represents the pistons B^3 and B^4 as having just completed their stroke in the direction of the cylinder A^2; consequently the valve is closed for these two cylinders, but the other two pistons B^1 B^2 are on their half-stroke, and are operating the valve D in the direction of the arrows in Fig. 5, so as to supply water to the passage E^2, at the same time opening the discharge from the passage E^4, and thereby reversing the motions of the pistons B^3 and B^4. By a continued repetition of the movements of the pistons, as above described, the connecting rods revolve the valve D, which supplies water successively to the four water ways, and discharges it therefrom. The set-screws *k* through the cylinder heads, as above referred to, afford adjustable abutments for stopping the
122 pistons at the outer terminations of their strokes at such points as will allow them to discharge the proper amount of water.

What I claim as new, and desire to secure by letters patent, is,

1. The combination and arrangement of the four cylinders A^1 A^2 A^3 A^4, the pistons B^1 B^2 B^3 B^4, and the rotary cylindrical valve D, provided with communicating slots *i i'* and passages *a c*, substantially as and for the purposes set forth.

2. The connecting rods C C', slotted and halved together, as described, in combination with four pistons, whose axes are all in the same plane, as and for the purposes described.

In testimony that I claim the above I have hereunto subscribed my name in the presence of two witnesses.

HENRY A. DESPER.

Witnesses:
W. E. DESPER.
DAVID W. POND.

Exhibit Sutherland Patent.

Letters patent of the United States, No. 78551, granted James Sutherland, June 2, 1868. Improvement in liquid meters.

The schedule referred to in these letters patent and making part of the same.

To all whom it may concern:

Be it known that I, James Sutherland, of Brooklyn, in the county of Kings and State of New York, have invented a new and useful improvement in liquid meters, of which the following is a full, clear and exact description, reference being had to the accompanying drawing, forming a part of this specification, and in which—

Fig. 1 represents a plan of a meter constructed according to my improvement, with the valves and their covers removed.

123 Fig. 2 a vertical longitudinal section, taken as denoted by the line *x x* in Fig. 1, and

Fig. 3 a transverse vertical section, taken as indicated by the line *z z* in Figs. 1 and 2.

Similar letters of reference indicate corresponding parts throughout the several figures.

My invention consists in the employment of two or more cylinders or measuring chambers, arranged preferably horizontally, and side by side, with pistons and valves for independent action, the same being so combined and geared, and the ways or passages so arranged, as that the piston, or, say, pistons, on either side alternately, and when half way, or thereabouts, of their travel through their cylinders, are caused to suddenly work or throw the valve or valves which control the piston or pistons on the opposite side, for the purpose of securing a reversal in the action of the same, whereby the cylinders are opened and closed suddenly, and kept open to fill and discharge, instead of being gradually opened and closed, and with no such latitude, as regards remaining open, as occurs where the valves are operated by the pistons, which they serve to control, instead of by independently-moving pistons, as in my improvement.

Said invention also includes a novel arrangement of valve-operating gear, for producing the action hereinbefore described.

Referring to the accompanying drawing, which shows the improvement applied to a four cylinder meter, embracing one set or pair of cylinders or measuring-chambers, with their connected pistons arranged side by side of another independent set or pair of cylinders, with their pistons connected or linked together, to work in unison with but independently of the adjacent set or pair of pistons A, is a central or intermediate box or chamber, which serves as a receiving compartment for the water or other liquid entering by an inlet, B, and from which the several cylinders, C C′ and D D′ are fed, by or through the action of valves, substantially as hereinafter described.

The sides and bottom of this chamber intermediate A are made hollow, or with connecting passages, E, for passing off the water from the cylinders to the outlet F.

Each pair of cylinders C C′ and D D′ are provided with pistons
124 G G, linked together by rods, *a a*, and yoke H or H′, said yokes receiving within them wrist pins *b b′*, which occupy a right-angled position, or thereabouts, relatively to each other, and a shaft, I, with which latter they are connected by cranks or disks *c c′*, whereby, on the pistons being reciprocated, a rotary motion is communicated to the shaft I, that, through a suitable indicator, thus serves to register the quantities of liquid passed through the cylinders or measuring-chambers of the meter.

The water is admitted to and exhausted from the cylinders, that is, either pair or set, C C′ or D D′, alternately, by slide valves, J J′, of a double D′-form or construction, that is, each valve made with two bonnets, *d d* and *d d′*. These valves control, as they are reciprocated in parallel directions to the pistons, ports *e*, *f*, *g*, and *h*, *i*, *j*, on or to the cylinders on the one side, and *e′*, *f′*, *g′*, and *h′*, *i′*, *j′*, on or to the cylinders on the other side, the ports *f i* and *f′ i′* being exhaust-ways in connection, by passages *k k* and *k′ k′*, with the passages E that lead to the outlet F, while the ports *e*, *g*, *h*, *j*, and *e′*, *g′*, *h′*, *j′*, connect, by ways, *l m* and *n o*, and *l′*, *m′*, *n′*, *o′*, *and l′*, *m′*, *n′*, *o′*, the ends of the cylinders C C′ and D D′ with the bonnets of the valves or water-receiving channels or spaces outside thereof, accordingly as said valves are reciprocated to cover or uncover the ports *e*, *g*, *h*, *j*, and *e′*, *g′*, *h′*, *j′*. There is this peculiarity, however, about the several cylinder-ports and their passages, which is that, while the ports *e j* communicate with the outer ends of the cylinders C C′ and the ports *g h* with the inner ends of said cylinders, the ports *e′ j′* and *g′ h′* communicate respectively with the opposite ends of the cylinders D D′. The receiving or supply chamber A, it may

be observed, is in constant communication by suitable openings with the valve-cover or covers K.

The valves J J′ are not operated by the pistons immediately over which they are arranged, but by the pistons of the adjacent pair of cylinders; thus the yoke H is made to operate the valve J′, and the yoke H′ the lever J. This is done, and suddenly, towards the closing half of the piston's stroke in either direction, by the yokes H H′ striking the tappets L L′, the one of which is secured to a shaft, R, while the other is secured to a sleeve, S, said shaft and sleeve carrying, at their opposite ends, arms M M′, which gear respectively with the valves J J′.

In illustration of the operation, supposing the pistons G G of the cylinders C C′ to be travelling as indicated by the arrows *y y* in Fig. 2, and to be situated as represented, when the pistons in the adjacent cylinders D D′ will be at the end of their left-hand stroke, then the continued motion of the pistons G G will cause the yoke H to trip the tappet L, and, through the arm M, suddenly throw the valve J′ so as to open the ports *g′ j′* and passages *l′ o′*, for water to enter the cylinders D D′, to start the pistons in the same direction as the pistons in the cylinders C C′ are running, and to pass off the water in front of the pistons of the cylinders to the outlet. A like action takes place as regards the reversal of the pistons in the cylinders C C′, at the end of their right-hand stroke, when the pistons in the cylinders D D′ reach half of their travel in said cylinders by the yoke H′ acting on the tappet L′, and through the lever M′ on the valve J.

In this way are the valves operated successively by the adjacent independent piston or pistons to that or those which they control, and being operated suddenly, and while the pistons which operate them are midway or thereabouts of their stroke, abundance of time is given for the cylinder or cylinders which they control to fill and discharge.

What is here claimed, and desired to be secured by letters patent, is—

1. A liquid meter, composed of two or more cylinders, fitted with independent pistons, when these latter are controlled by valves, operated so that either one piston or connected pair or set of pistons is or are made to actuate the valve which controls the other piston or connected pair or set of pistons, substantially as specified.

2. The combination of the cylinders C C′ and D D′, with their pistons and valves, so arranged and operating as that either one set of pistons to said cylinders are reversed in their action by the motion of the valves which control them, when the other set of pistons are midway of their stroke or thereabouts, essentially as herein set forth.

3. The combination of the cylinders C C′ and D D′, with their pistons, yokes H H′, tappets L L′, arms M M′, and valves J J′, for operation together, and in connection with suitable inlet and outlet passages, substantially as shown and described.

JAMES SUTHERLAND.

Witnesses:

JOHN W. COOMBS, JR.

EDW'D P. TRACY.

Exhibit Spencer and Meyer patent.

Letters patent of the United States, No. 55547, granted Elihu Spencer and E. L. Meyer, June 12, 1866. Improvement in water-meters.

Specification.

To all whom it may concern:

Be it known that we, Elihu Spencer and Ernest L. Meyer, of Elizabeth, in the county of Union and State of New Jersey, have invented a new and useful improvement in water-meters, and we do hereby declare that the following is a full, clear and exact description thereof, which will enable others skilled in the art to make and use the same, reference being had to the accompanying drawing forming part of this specification, in which—

Fig. 1 is an elevation of a water-meter and box made according to my invention, the cover of the valve chamber being removed.

Fig. 2 is a vertical cross-section, in the plane indicated at x, x, Fig. 1.

Similar letters of reference indicate like parts.

In this improvement in water-meters we employ two cylinders and sliding valves, the valves working in a valve chamber common to both of them, and all being arranged together in a box, in whose rear side is placed the water supply pipe. A crank shaft, which is connected with the pistons by a yoke, gives motion through a worm and gear wheel to a dial, which indicates, through a fixed index, the quantity of water discharged.

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The letter A designates a box which incloses on all sides, except the front, an apparatus made and arranged according to our invention. A water supply pipe, O, passes through the back side of the box into a valve chamber, M, which is placed between two pump cylinders, B, B, that stand on the bottom of the box, as shown in the drawing.

The letter I designates studs, which are cast with the box A, and project from its inner side so as to form supports and guides for the piston rods, C, C, and bearings for the crank shaft, D. I′ designates a stud upon which is formed a spindle that carries a gear wheel, F, upon whose face may be placed a dial. We have not considered it necessary to show such a dial, because any skilful artisan can construct and apply one to the apparatus without further explanation. Upon the point of the spindle is fixed an index, which remains stationary while the gear wheel, F, which carries such dial, rotates behind it. R, R are two valve seats formed within the valve chamber, M, to which are fitted slide valves, N, whose valve stems, K, are suitably attached by links to eccentrics, G, G, placed on the horizontal crank shaft, D, which is driven from the pistons, C, C. J, J are cranks placed on the shaft, D, and working in oblong slots, Q, formed in the piston rods, after the well-known method of converting reciprocating into rotary motion. K, K^1, K^2, K^3, are parts which communicate with the upper and lower parts of each cylinder, above and below its piston, and open through the valve seats into the valve chamber at such points that they may be alternately covered and uncovered by the slide valves, N.

The letters L, L designate channels which communicate with the supply pipe, O. When any of the ports or channels, K, K^1, etc., are uncovered by the slide valves, the water is discharged from the cylinders into one of the spaces, S, of the valve chamber, whence it escapes to the discharge pipe, P, to be used wheresoever it is conducted. When the valves are in the position seen in Fig. 1, the water enters the channels,

L, and passes through the ports, K^1, to the lower part of the left-hand cylinder, B, and also through the port, K^2, to the upper part of
128 the right-hand cylinder, forcing the piston of the former upward and that of the latter downward. During such change in the pistons, the water already in the cylinders will be forced out, that in the upper part of the left-hand cylinder passing through port or channel, K, into the upper space, S, and that in the lower part of the right-hand cylinder through channel, K^3, into the lower space, S. The spaces, S, being always in communication with the discharge pipe, P, are cleared of water as fast as it runs into them.

We have shown the channels, K, K^1, K^2, K^3, and channels, L, and the ends of the valves, N, as if they were made open; but we have done so only to illustrate their construction and the operation of the apparatus. They are to be covered so that the valves, N, and the channels, L, will only communicate with each other and with the channels, K, K^1, K^2, K^3, and that the latter will communicate with the interior of the valve chamber only when they are uncovered by the valves. The slide valves are operated by the eccentrics of the shaft, D. Between these eccentrics we place a worm wheel, E, which works in a gear wheel, F, whose rotations, with the aid of the fixed index, T, may be made the means of indicating the numbers of strokes of the pistons or the quantity of water that has passed through the cylinders, the force or head of the water that comes through the supply pipe relied on to work the pistons.

It will be observed that in this arrangement of parts herein shown, one piston is made to control the other, so that the dead centre in the revolution of one crank is overcome by the movement of the other. The box A and the studs I I′ can be cast together; also the cylinder and valve seats R, R, can be cast in one piece. The whole apparatus is arranged in its box A, in a compact form, and is not easily liable to get out of order. We claim as new and desire to secure by letters patent—

1st. A water meter made and arranged substantially as above shown, that is to say, consisting of two cylinders, having a common valve chamber between them, within which valve chamber are placed two slide valves operated substantially as described by means of a shaft ro-
129 tated by proper connections from the pistons of the cylinders, such shaft carrying a worm E, which rotates a gear-wheel F, whose spindle carries a fixed index, all as above set forth.

2d. We also claim combining the said apparatus mentioned in the preceding clause with an enclosing box A, in the manner substantially as above shown.

ELIHU SPENCER.
ERNEST L. MEYER.

Witnesses:
JOHN H. HOWLAND.
THOMAS G. WARD.

Exhibit Barden patent.

Letters patent of the United States, No. 50651, granted John S. Barden, assignor to the New England Butt Company, of Providence, R. I., Oct. 24, 1865. Improvement in hydraulic engine and meter.

Specification.

To all persons to whom these presents shall come:

Be it known that I, John S. Barden, of the city and county of Providence

and State of Rhode Island, have invented an improved hydraulic engine, and I do hereby declare the same to be fully described in the following specification, and represented in the accompanying drawings, of which Fig. 1 is a horizontal section and Fig. 2 a longitudinal and vertical section. Fig. 3 is a vertical and transverse section taken through one pair of the cylinders and their two connecting pistons. Fig. 4 is a horizontal section taken through the valve seats. This engine is designed to be either a measurer of the flowage of a liquid or a gas, or to be used as a mechanical motor, to be operated by the agency of either steam, gas or water. By applying to its main shaft a proper registering apparatus, the engine may be used as a meter for determining the quantity of water which in any given time may flow through it under pressure; so by properly combining with the main shaft any mechanism, the engine may be employed to impart motion to such mechanism.

In constructing this engine I make use of four cylinders, A, A′, B, B′, which are closed at their outer ends and arranged relatively to an eduction chamber, C, in manner as shown in the drawings, such cylinders at their inner ends being made to open into such chamber. In each of the said cylinders there is a piston D. The two pistons of each pair of cylinders, whose axes are in one straight line, are connected by two rods, *a*, *a*, so that when one of such pistons is moved in its cylinder a corresponding movement of the other in its cylinder will take place. A port or passage, *b*, leads from the outer end of each cylinder to one of two ports of each cylinder to one of two valve seats, E, E, arranged on the bottom of a valve chest, F. Between the two ports of each pair of cylinders there are two eduction ports, *c*, *c*, which lead through the valve seat and open communication between the interior of the valve, G, thereof, and the eduction chamber, C, through whose bottom there should be one or more holds of discharge.

Furthermore, within the induction or valve chamber, F, there are two of the said valves, G, G, which rest on the seats, E, E. An under side view of one of the valves is exhibited in Fig. 5, wherein the said valve is shown as provided with three chambers, *e*, *f*, *g*, the middle one, *f*, of which is rectangular in shape, and is to receive one of two cranks or pins, *h*, *h*, which project from the two heads or rings, *i*, *i*, that encompass and are fastened on two vertical shafts, *k*, *k*, arranged within the eduction chamber, C. Each of the shafts, *k*, *k*, has a bell-crank, *l*, from which one of two connecting rods, *m*, *m*, leads to and is jointed to one of the pistons of each pair of the connected pistons, the said cranks and connecting rods being arranged as shown in Figs. 1, 2 and 3. Below its bell-crank, and fixed on each of the shafts, *k*, *k*, there is a pinion, *n*, which engages with a connecting gear, *o*, arranged between the two shafts, and on the main shaft, H, to which allusion has hereinbefore been made.

While the two bell-cranks, *l*, *l*, are arranged so as to stand at right angles to each other, and the two valve operative cranks, *h*, *h*, are also disposed at right angles to each other, each of the said bell-cranks is arranged at right angles relatively to the valve crank of its shaft. These arrangements of the cranks cause each of the valves to be properly operated, and each of the bell-cranks to be assisted over its "dead points" by the other of the said bell-cranks. Over the valve chest there is a chamber or box, K, for containing a registering apparatus, when applied to the main shaft, which extends into such chamber.

For operating the engine, water, steam or a gas under pressure is to be introduced into the valve chest by a pipe or conduit leading therein. By its action on each of the pistons each pair of them will be set in motion,

the pairs being moved so as to produce by the machinery connecting them with the main shaft a continuous rotation of it. The water while being discharged from each cylinder, while the piston thereof is being moved towards the head of such cylinder, will be returned through the port leading from the cylinder and will be driven into the eduction chamber, C, from which it will be discharged by the hole or holes *d*.

I claim, as my invention, the improved engine substantially as described, the same consisting of the four cylinders, A, A′, B, B′, the two pairs of connected pistons, D, D, D, D, and the eduction chamber, C, arranged as explained, in combination with the main shaft, H, or its equivalent, the valve chest, F, valves, G, G, ports, *b*, *b*, *b*, *b*, and mechanism to operate such valves by the pistons, substantially in manner as specified.

JOHN S. BARDEN.

Witnesses:
R. H. EDDY.
J. P. HALE, JR.

132 *Complainants' Exhibit Hartin patent.*

Letters patent of the United States, No. 9746, granted John Hartin, May 24, 1853.

Specification.

To all whom it may concern:

Be it known that I, John Hartin, of New York, in the county and State of New York, have invented certain new and useful improvements on a "fluid metre," and I do hereby declare that the following is a full, clear and exact description of the fluid metre with the improvements, reference being had to the accompanying drawings, and to the letters of reference thereon, all of which form a part of this specification.

The same letters of reference always designating the same object or part of the metre in all the figures.

OF THE DRAWINGS.

Fig. 1 is a longitudinal vertical section.

A, is a cylinder.
B, is a piston.
C, is the piston rod, to which is attached
D, an arm, which plays, by means of a pin, in a slit in
E, a connecting piece, which operates
F, a lever, to the top of which is attached
G, a ball.
H, *H*, are two slitted connecting rods, which operate
I^1, I^2, I^3, three sliding valves.
K, *K*, *K*, are passages for the fluid to enter into the cylinder.
L, *L*, *L*, *L*, *L*, are passages for the fluid to be discharged from the cylinder.
M, *M*, are joints in the connecting rods (H, H).
133 *N*, is an index for ascertaining how much fluid is discharged from the cylinder.
O, is a finger, fixed to the piston-rod for marking the index.
P, is a sliding box for regulating the stroke of the piston and the quantity of fluid in the cylinder.

Q, is a screw by which the sliding-box (P) is moved.
R, is a sliding piece, to be regulated in conjunction with the sliding-box (P).
S, is a screw to set the sliding piece (R).
T, *T*, are two flexible metallic rings placed around the piston to cause it to move tight in the cylinder.
U, *U*, are openings in the piston through which the fluid acts on the metallic rings (T, T).

Fig. 2 is a sectional end view, through the centre of the cylinder.
A, is the cylinder.
I, is a sliding valve for opening and shutting the passages through which the fluid enters into the cylinder.
K, is a passage for fluid to enter into the cylinder.
L, is a passage for the discharge of the fluid from the cylinder.

Fig. 3 is a perspective view of the piston.
T, *T*, are two flexible metallic rings.
U, *U*, *U*, are openings through which the fluid acts on the metallic rings and forces them outward, thus causing the piston to move tight in the cylinder.
V, is a cut through the metallic ring to allow it to expand.

The nature of my invention consists, "in providing the cylinder, inside, with a sliding box or stop (P), which is adjusted in its position by a screw (Q), by which means I can limit the stroke of the piston by causing it to strike against the said box, or stop, for the purpose of preventing the pin in the arm D from straining upon the stop R, in the slotted arm E, after tilting the lever F. The sliding box (P) in the cylinder, and the sliding piece (R), in the slotted connecting piece (E), have to be regulated, proportionally, so as to have the oscillating
134 ball (G), with its lever (F), operate the valves properly. I make slits in the two connecting rods (H, H), which operate the valves, and make likewise a slit in the connecting piece (E); by the combination of these two slitted connecting rods (H, H) and the slitted connecting piece (E) with the oscillating ball (G) and lever (F), I obtain a sudden change of the valves; whenever the piston has moved to a certain place in the cylinder I make the fluid itself cause the piston to move tight in the cylinder by means of openings (U, U, U, Fig. 3) on the faces of the piston; these openings run obliquely (U, U, Fig. 1) towards the inside of metallic rings placed in grooves around the piston; through the said openings the fluid presses against the inside of the metallic rings which are cut through in one place as shown (V, Fig. 3) and cause them to expand and press tight against the cylinder. I place an index (N, Fig. 1) near the piston-rod, and a finger or point (O) on the piston-rod, by which means I ascertain how much fluid is drawn off from the cylinder."

To enable others, skilled in the art, to make and use my invention, I shall further describe its construction and operation:

I construct a cylinder A, with its necessary passages (K, K, K, L, L, L, L, Fig. 1) for the fluid to enter and to be discharged through, and proper places for the valves, as shown in the annexed drawings; into this cylinder, after it has been accurately bored inside, I fit a piston (B) tightly, allowing it to move freely; around this piston I put flexible metallic rings, fitted into grooves nicely; said rings I cut off in one place (V, Fig. 3) so that they can expand; on the face of the piston I make oblique openings toward the inside of the metallic rings. The rod of the piston passes through one end of the cylinder; at the other end of the cylinder inside, I place a round box (P) which is fitted closely

around a projecting piece and made to slide on it by means of the regulating screw (Q); this box (P) is to limit the stroke of the piston. I place one sliding valve in the passage over the cylinder (I, Fig. 1) and two sliding valves at their proper places in the passages below the cylinder (I^2, I^3); to the upper valve (I') I attach a connecting rod H, joined at M, said connecting rod being slitted at the end, and connected with a lever (F) by means of a pin on the lever passing through this
135 slit; to the two lower valves I attach likewise a connecting rod and connect it with the lever F, in the same manner as the upper connecting rod; to the piston rod I fix a short arm (D), and connect this arm with the lever (F) by means of a slitted connecting piece (E), and a pin on the arm (D), which pin plays in the slit of the connecting piece (E); at the end of this slit I fit a sliding piece (R), to be operated by a screw (S); the piece (R) has to be regulated in conjunction with the sliding box (P), in the cylinder, for the purpose as hereinbefore stated. At the top of the lever (F) I place a ball (G). I put an index (N) near the piston-rod, and a point (O) on the piston-rod to mark the index.

Now, if the fluid enters through one passage at the top into the cylinder, it will force the piston along in the cylinder, and at the same time act against those metallic rings on the piston, and force them outward, thus preventing the leakage of the piston. When the piston is moved to a certain place in the cylinder, the piston-rod acts, by means of the arm (D) and its pin in the slit of the connecting piece (E), on the lever (F), and carries the oscillating ball (G) over the centre, when the weight of the ball (G) carries the lever (F) down quickly, and as quickly changes the valves; the top valve closes the passage where the fluid just entered one end of the cylinder and opens the other passage for the fluid to pass into the other end of the cylinder: at the same time that the upper valve changes, the two lower valves change also, one valve allowing the fluid which passed into the cylinder on one end to be discharged while the other valve is closed and the fluid is passed into the cylinder at the other end, thus causing the piston to move to and fro in the cylinder. The slits in the connecting-rods (H, H) of the valves are for the purpose of leaving the valves undisturbed until the oscillating ball (G) is carried over the centre, when it causes the valves to change quickly. The index (N) marks the quantity which may be discharged during one stroke of the piston; to ascertain how many cylinders of fluid have been drawn another index must be attached to the meter.

Having thus fully described my improved fluid meter, what I claim as my invention and desire to secure by letters patent is, the ad-
136 justable box or stop P, in one end of the cylinder, for the piston to strike against, for the purpose of preventing the pin in the arm D from straining upon the stop R, in the slotted arm E, after the tilting of the lever F, substantially as herein set forth.

JOHN HARTIN,
No. 116 37th Street, New York.

Witnesses:
E. DELAFIELD SMITH.
J. FREEMAN SELKE.

EVIDENCE FOR COMPLAINANTS IN REPLY.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States, in equity, as amended, before me.

JOHN G. STETSON,
Examiner.

BOSTON, *March* 22, 1877.

Present, Andrew McCallum, esq., of counsel for complainants; James M. Maynadier, esq., of counsel for defendants.

Deposition of Porter Davis.

Direct examination by ANDREW MCCALLUM, Esq., of counsel for complainant:

Int. 1. Please state your name, age, residence, and occupation.

Ans. Porter Davis; forty-five; Worcester, Mass. I am in the employ of the city of Worcester. I work on meters mostly; read and put on meters.

Int. 2. Are you familiar with the water meters made by William E. Desper & Co.?

Ans. I am.

Int. 3. Please look at complainants' Exhibit 6, and say whether or not that is one of the meters referred to.

137 Ans. I should say it was.

Int. 4. Have you any knowledge as to how these Desper meters are adjusted with regard to the length of stroke of the piston and the consequent discharge of water? If you have, state all you know about it?

Ans. In 1874 or 1875, Mr. Desper had meters at the city shop trying. One meter was found to give too much water. He said he would take it to his shop and change it, or, if we would give him tools, he could do it there. I furnished him with tools, and he turned in the screws on the heads to make it give the right quantity of water.

Int. 5. Do these meters ever require repairs, so as to readjust the length of the piston to make the meter measure accurately? If they do, state how it is accomplished.

Ans. There has been meters repaired this winter, and in testing the meters after being repaired we have found they gave from sixty-eight to seventy pounds of water to the foot, when they only ought to give sixty-two and one-half pounds. We have sent them back to Mr. Desper's shop, and when they have been returned the screws in the heads have been turned in or lengthened out by soldering or putting on a nut as in the case of the exhibit produced.

(This exhibit is produced by witness as a part of a Desper meter, and is put in evidence for complainants, and marked Complainant's Exhibit Davis, J. G. S., examiner.)

Int. 6. Do you refer to the nut on the inside of the exhibit?

Ans. Yes, sir. In January the meter from which this exhibit was taken was repaired; gave, running ten feet, seven hundred and seven pounds of water in excess.

Int. 7. Did the screwing in of the screw and the addition of the nut on the inside have the effect of shortening the stroke of the piston and rectifying this error in the measurement, or what effect had the alteration of the stop upon the operation of the meter?

Ans. I think that it did. The meter was repaired again last week, and it now gives, running ten feet, six hundred and three and one-half pounds of water.

Int. 8. Were these Desper meters always the same as they are
138 now with regard to the adjusting screws and stops in the cylinder heads?

Ans. When they first came to the shop there was a head and nut on

them and they were cut off. My orders were to have none go on the work without the nuts or heads being cut off.

Int. 9. What reason was assigned, if within your knowledge, requiring the heads of the screws to be cut off before the meters were put in use?

Ans. So that they might not be tampered with.

Int. 10. You have spoken of directions you received. From whom did you receive directions to cut off these screw heads, or to have them cut off?

Ans. From the water commissioner.

(Complainants' counsel here puts in evidence certified copy of a minute of the joint standing committee on water of the city of Worcester, which is marked Complainants' Exhibit Water Committee Vote, J. G. S., examiner.)

Int. 11. Please look at said exhibit, and say whether or not you are cognizant of this action of the water committee?

Ans. I heard there was such a vote passed by the committee.

(Objected to as hearsay.)

Int. 12. Is it your duty to receive the meters made by Desper & Co., and sold by them to the city of Worcester?

Ans. I have received some meters.

Int. 13. Have you ever received any of these Desper meters in the ordinary course which had the slots in the piston-rods partially filled up or made narrower at the ends than in the middle, instead of being of equal width throughout the length?

Ans. The last meter that I received from them the slots were narrower at the ends.

Int. 14. Have you that meter in your possession? If so, produce it.

Ans. I have; and here produce it.

(Meter referred to is put in evidence for complainants, and marked Complainants' Exhibit Davis No. 2, J. G. S., examiner.)

Int. 15. When did you receive that meter?

Ans. Dec. 23, 1876.

139 Cross-examination by JAMES E. MAYNADIER, Esq., of counsel for defendants:

Cross-int. 16. Please read over your sixth answer and say whether you really mean that that meter, running ten feet, measured seven hundred and seven pounds of water more than it ought to have measured?

Ans. I meant that that meter in registering ten feet gave seven hundred and seven pounds of water, which should have given, if it had been right, six hundred and twenty-five pounds.

Cross-int. 17. Why do you say that the slots in Exhibit Davis No. 2 are narrower at the ends?

Ans. They appear to be so, looking at them.

PORTER DAVIS.

Attest.

JOHN G. STETSON,
Examiner.

Deposition of Ivers Gibbs.

Direct examination by ANDREW MCCALLUM, Esq., of counsel for complainants:

BOSTON, *March* 22, 1877.

Int. 1. What is your name, age, residence, and occupation?

Ans. My name is Ivers Gibbs; fifty-six; Worcester, Mass.; pattern maker by trade.

Int. 2. How long have you been engaged in the business of pattern making? And state if you are in the habit of making models from drawings and descriptions. Give your experience in this regard.

Ans. It has been nearly thirty years since I followed the business, principally, of pattern making. I have been in the habit of making patterns and models from drawings and descriptions during most of that time.

Int. 3. Please look at Defendants' Exhibit Ball and Fitts 1869 Patent, and say whether or not you understand the same and could make a model or meter from the drawings and specifications of that patent?

140 (Objected to as wholly immaterial.)

Ans. I think I could make a model from these drawings.

Int. 4. Please look at Complainants' Exhibits No. 1 and No. 4, and say whether or not you understand the same and could make a model or meter from the drawings and specifications of such patent, the construction of the valve being the same as in the 1869 patent?

(Same objection.)

Ans. I could make a meter from these drawings with the valve of the 1869 patent.

Int. 5. Would you find any difficulty in placing the valve of the 1869 patent in a meter such as is shown and described in the Complainants' Exhibits Nos. 1 and 4?

(Same objection.)

Ans. I apprehend no difficulty in it.

Int. 6. Would you require to add or invent anything which is not shown by said Exhibits 1 and 4?

(Same objection.)

Ans. I do not know of any invention required there, simply a matter of location of the valve of the 1869 meter into the 1870 meter.

(Complainants' counsel here puts in evidence a certified duplicate of the Patent Office model in the matter of letters patent granted Phinehas Ball and Benaiah Fitts, Nov. 22, 1870, No. 109272, reissued March 24, 1874, No. 5806, and assigned to the Union Water Meter Company, which is marked Complainants' Exhibit Duplicate Model, J. G. S., Examiner.

Defendants' counsel objects to the introduction of this exhibit and to any use thereof in this case.)

Int. 7. Please examine said model exhibit and compare it with the drawings of Complainants' Exhibit 4, and say whether or not said drawings represent the model, and whether they are the same or different in any particular.

(Objected to as wholly immaterial.)

Ans. I see no variation, with one exception: the walls of the slot in the connecting-rod are not drawn out to its upper and lower extremities in Fig. 1.

141 Int. 8. In Complainants' Exhibit 4 and Duplicate Model, how is the valve removed?

(Same objection.)

Ans. Water acts upon the piston-rod which turns the crank, the crank having a bevel-gear upon it working into a bevel-gear attached to the valve.

Int. 9. How is it with the 1869 patent of Ball and Fitts? Is that a crank motion, or what?

(Same objection, also as leading.)

Ans. I should call it a cam motion.

Int. 10. Is there any crank shown or described in said patent, or by what means is the valve rotated?

Ans. I see no crank. There is represented in this meter a disk on the shaft, with two pins working into cam-slots in the connecting rods.

Cross-examination (de bene esse) by JAMES E. MAYNADIER, Esq., of counsel for defendants:

Cross-int. 11. Look again at Fig. 1 of the reissued patent, and tell us whether the wrist-pin and its friction-roll is on the side of the crank nearest to you or not.

Ans. I should say it was; it looks so here.

Cross-int. 12. And the crank-shaft is attached to the main part of the crank on the side farthest from you as you look at it, isn't it?

Ans. It is so drawn here.

Cross-int. 13. And the crank-shaft must, therefore, pass through the connecting-rod, musn't it, or else be very short?

Ans. It is drawn against the connecting-rod there. I don't see how it could pass through the connecting-rod there.

Cross-int. 14. It must pass through unless it is a very short shaft, mustn't it, according to that drawing?

Ans. From the way I understand this, there is a mistake in dotting the lines of the shaft and in not dotting the lines of the crank-pin and roll, instead of making full lines.

Cross-int. 15. Fig. 1 is wrong, then, isn't it, in two other respects in addition to the one you have named in your direct examination, that is, in not showing the slot correctly?

142 Ans. It would be unless we looked at it from the other end of the shaft; in that case the lines for the crank-pin would be correct, and the dotted lines of the shaft also correct.

Cross-int. 16. Take the drawing as it is, and answer the preceding question.

(This question objected to, for the reason that the specification referring to the drawing describes it as a sectional view, but does not intimate from which side of the meter you are to look at it.)

Ans. I suppose it is, according to the rules of drawing, strictly speaking.

Cross-int. 17. That figure also shows clearly that the wrist-pin is not in the slot, but that the crank-arm lies between the slot and the wrist-pin, and is wholly wrong in this respect, isn't it?

Ans. The crank-arm is drawn between the eye and the connecting-rod, looking at it as in Fig. 1.

(Question being reread, the witness adds:) It is wrong in this respect.

Cross-int. 18. Now, suppose the crank-shaft in Fig. 1 were shown in section, and the wrist-pin and its friction-roll were shown by dotted lines, that is, on the other side of the crank-arms, and as projecting into the slot, wouldn't the wrist-pin bring up against the top or bottom of the slot, and thereby prevent the crank-shaft from making a revolution?

Ans. It would as it is drawn here.

Cross-int. 19. Now examine Fig. 2 of the reissue, and state what is shown in that figure to keep the crank-shaft marked *i* in that figure in its place, if anything?

Ans. That portion of the drawing marked *i* is a sleeve attached to the yoke, and this sleeve incloses the crank-shaft, as I understand it.

Cross-int. 20. What makes you think the part marked *i* in Fig. 2 is a

sleeve and not the crank-shaft? And refer, if you choose, before answering, to the left hand column on the second page of the reissue specification.

Ans. Well, there is a line drawn across it at each end of the sleeve *i*, showing there is a joint there; also dotted lines in the crank-shaft in Fig. 1.

143 Cross-int. 21. Doesn't the upper one of the two lines you speak of show that the hub on the upper crank-arm there comes into contact with the end of the crank-shaft *i*?

Ans. I understand that the hub on the crank-arm forms a shoulder against the sleeve.

Cross-int. 22. Isn't the lower one of the two lines you speak of the upper line of the bevel-pinion?

Ans. It may represent that as well as the end of the sleeve.

Cross-int. 23. Isn't the crank-arm very much larger as shown in Fig. 2 than as shown in Fig. 1?

Ans. Yes, sir; it looks so here; it is so.

Cross-int. 24. And isn't it also very much larger in Fig. 2 than in Fig. 4?

Ans. It is larger.

Cross-int. 25. Could the crank make a revolution if the connecting-rod was constructed as shown in Fig. 4, if the wrist-pin were in the slot?

Ans. If this drawing in Fig. 4 was intended to represent the slot it could not make a revolution there.

Cross-int. 26. Isn't the slot in Fig. 4 the same as the slot in Fig. 1, except a trifle narrower and without the little curved places on the long side?

Ans. Very nearly the same.

Cross int. 27. Doesn't Fig. 1 show one side of the connecting-rod and Fig. 4 the other side of the connecting-rod?

Ans. Yes, sir; I think it does, as far as I can tell about it.

Direct examination resumed:

Int. 28. In speaking of the slots you have just been testifying about, do you refer to the rectangular openings in the connecting-rods?

Ans. I do.

Int. 29. Are these the slots in which the crank-pins are inserted, and which operate the crank in this machine?

Ans. It may be intended as an opening in this drawing. I don't know for what purpose the opening is there, if it is an opening.

(Question reread, and witness instructed by counsel that he
144 may refer to Fig. 2, which shows a plan view of the meter. Witness then adds:) Those rectangular openings are not the slots which operate the crank according to the plan of Fig. 2, and the wrist-pins are not in it.

Int. 30. Then, in your previous answers you understood the questions to refer to the rectangular openings and not to the operating slots of the piston; is that correct?

(Objected to as leading.)

Ans. It is correct.

Int. 31. Just look again at Fig. 2 and see if there is anything in the form of operating slots which would prevent or impede the motion of the crank-arm?

Ans. There is not.

Int. 32. Then, in your answers to former questions respecting the

movement of the crank-arm by coming in contact with the upper or lower ends of the slots, you referred to the rectangular openings in the slots and not to the operating slots in the rods, did you not?

(Objected to as leading.)

Ans. I did.

Int. 33. Look again at Fib. 2 in the drawing, and suppose the meter to be cut off on the line *x x*, and that Fig. 1 represents the upper portion of Fig. 2 cut off on that line, would not the crank-arm *m*, as shown in Fig. 1, be in proper position, the position of the shaft *i* being shown by dotted lines?

(Objected to as leading.)

Ans. Yes; I think it would, as far as I can judge about it.

Int. 34. Fig. 1 is a sectional view, is it not?

Ans. I so understand it.

Int. 35. Would said figure, as you understand it, be a fair representation of the machine, as shown by Fig. 2, as cut off on the line *x x*, except that the walls of the operating slots are not fully shown?

(Same objection.)

Ans. It would.

Int. 36. Please look at Fig. 4, and refer to the description of the same on the first column, page one, and say what it represents, and whether or not the figure is properly represented and described.

145 Ans. It is a sectional view of the part cut off; it seems to be correctly represented.

Int. 37. What is represented by Fig. 3?

Ans. It is a cross-section of Fig. 1.

Int. 38. Is there anything in the drawings of the Complainants' Exhibit 4 which you do not understand, or which would prevent you from making a meter such as Complainants' Exhibit Duplicate Model, supposing you had never seen said model or one like it?

(Objected to as leading, as improper on the direct resumed, and as wholly immaterial.)

Ans. I have no doubt but what I could make a meter from these drawings.

Cross-examination resumed (de bene esse):

Cross-int. 39. What do you think those two circles in Fig. 4, marked *m*, represent?

Ans. I suppose the inner one represents the crank-shaft and the outer one the sleeve by which the crank-shaft is enclosed; it may, however, have reference to the crank-arm on the crank-shaft.

Cross-int. 40. It is impossible for two circles to represent the crank-arm, isn't it?

Ans. Two circles could not represent the crank-arm, not fully.

Direct examination resumed:

Int. 41. Would not the hub of the crank-arm be properly represented by two circles?

Ans. It would.

IVERS GIBBS.

Attest:

JOHN G. STETSON,
Examiner.

Second deposition of Benaiah Fitts.

BOSTON, *March* 23, 1877.

Direct examination by ANDREW MCCALLUM, Esq., of counsel for complainants:

Int. 1. What is your name? You have previously testified in this cause, have you not?

116 Ans. Benaiah Fitts. I have.

Int. 2. If within your knowledge, please give the history of the meter Complainants' Exhibit 5.

Ans. It was made by the Union Water Meter Company in 1870. In March, 1871, it was put on to the city water-works and certain premises in the city of Worcester for the purpose of measuring water used on those premises. The reading of the meter was taken by the city officials and the amount charged to the occupant of the premises in the usual manner of assessing the water rates. It has been so used in practical operation from that time until Nov. 14, 1876, when it was taken off, and afterwards brought into court and filed as an exhibit in this cause. It has never failed to operate, and was in good working order when taken off. It was once, however, about three years ago, taken off and tested, and put back without any alterations or repairs.

Int. 3. Do you consider it to be in good working order now, when properly fitted together?

Ans. I do.

Int. 4. Who prepared your application for letters patent No. 109372, patent dated Nov. 22, 1870, the model for which is represented by Complainants' Exhibit Duplicate Model?

(Objected to because of the reference to the Exhibit Duplicate Model.)

Ans. I prepared it myself.

Int. 5. Did you fix up the model which is filed in the Patent Office, of which this exhibit is a duplicate?

Ans. I did.

Int. 6. Please explain why you made the rectangular openings in the piston-rods which are shown by the model and represented by the drawings of said patent.

(Same objection.)

Ans. I did it to bring clearly to view certain parts of the device which I thought could not be as well shown in any other way, particular reference being had to the crank and the stops.

(Complainants' counsel here puts in evidence copy of Patent Office drawing of patent No. 109372, the same being photographic duplicate

117 of the original drawing accompanying said patent, and is marked Complainants' Exhibit Duplicate Drawing, J. G. S., examiner.)

Int. 7. Please look at said drawing and say whether or not you know who made the original drawing of which this is a duplicate.

Ans. I believe I made it myself.

Int. 8. Please look at Complainants' Exhibit 1, and say whether or not you know who made the drawings that accompany that copy of the patent.

Ans. I do not. I suppose they were prepared at the Patent-Office.

Int. 9. Do you consider the drawing Exhibit Duplicate Drawing a correct representation of the meter?

Ans. I do; so far as it goes.

Int. 10. What does Fig. 2 represent?

Ans. It is an elevated section drawn through the line *x y*, Fig. 1, look-

ing towards the main part of the meter, showing the end of the crank-pin and roll and a section of the connecting rod.

Int. 11. Please look at Fig. 1 of the reissued patent, Complainants' Exhibit 4, and say what that represents.

Ans. It purports to be a sectional elevation of the meter drawn through the line *x x*, looking from the main body of the meter, or looking at the cut off portion.

Int. 12. Please look at Defendants' Exhibit Ball and Fitts 1869 Patent, and also at Complainants' Exhibit 4, and describe what, if any, difference there is between them with regard to the construction of the piston rods and devices for operating the valve; also what, if any, difference there is in the result accomplished by said devices.

Ans. In reply to the first part of the question, I would say the devices in the patent of 1869, which rotate the valve, consist of face-plates or disks placed upon the shaft beside the connecting rod, in each of which are two pins; these pins play in slots in the connecting rod, in such a manner as that the piston, passing back and forth, gives rotary motion to the shaft. This motion is a sort of tappet motion, using a succession of tappets to make a continuous rotary motion of the shaft. This motion of the shaft is not an even, steady motion, but is a little accelerated, then retarded, then accelerated, then retarded, at
148 each stroke of the piston. The device in Complainant's Exhibit 4 is the common crank movement, with the crank-pin playing in a cam slot, the movement of which is, in relation to the piston, gradually retarded from the commencement of the stroke till the crank reaches a right angle with the piston rod, then is gradually accelerated to the end of the stroke. In answer to the second branch of the question, I would say, in the patent of 1869 the valve does not open its ports exactly in in proportion to the speed of the piston, and, as its motion is unsteady, it gives a pulsation to the stream of water as it passes through the meter, which is very objectionable in any meter. In Complainants' Exhibit 4 the valve commences to open just in time to throw the piston forward, and continues to open it just in proportion to the velocity of the piston till the crank reaches a right angle with the piston rod, then closes it in the same manner, so that the opening in the port is always in proportion to the velocity of the piston; this gives an even flow in the stream of water.

Cross-examination by JAMES E. MAYNADIER, Esq., of counsel for defendants:

Cross-int. 13. Refer to your answer to int. 11, and state whether Fig. 1 of Exhibit 4 does not show the crank arm between wrist pin and the slot of the piston rod.

Ans. I suppose it does.

Cross-int. 14. Does it not show the slot in the piston rod as rectangular in shape, with the exception of the small curve marked *c*?

Ans. There is a mistake in that figure where it seemed to be designed to show the full form of the connecting rod. How far that mistake goes I am not able to say. There is a rectangular slot shown, but it is not the full form of the slot referred to for the crank-pin to operate in; but it looks as though it might have been drawn from the back side of the other connecting rod, which has a rectangular hole or slot through it, which was cut away in the model to show the position of the crank. Therefore, to construct this meter we should have to refer to the other figures for our information.

Cross-int. 15. There are but three views of the slotted part of the

connecting rods in the drawings of the reissue, and one of these
149 views is an edge or plan view. The view on Fig. 1 shows one side, and the view on Fig. 4 shows the other side. Is not this correct?

Ans. Fig. 4 shows one side; Fig. 1 shows a part of the other side; otherwise, the question is correct, I believe.

Cross-int. 16. Can you see the two circles marked *m* in Fig. 4?

Ans. Yes, sir.

Cross-int. 17. What do they represent, in your opinion?

Ans. They represent a portion of the crank and the end of the crank shaft.

Cross int. 18. The inner circle you believe, I suppose, represents the end of the crank shaft?

Ans. Yes, sir.

Cross-int. 19. How can the outer circle represent any part of the crank, in view of Figs. 1 and 2?

Ans. I am unable to see any discrepancy particularly, except perhaps a little in proportion.

Cross-int. 20. Why isn't that outer circle shown on the part marked *m* in Fig. 1?

Ans. I should judge that the dotted circle in Fig. 1 and the outside line are designed to represent the two circles in Fig. 4.

Cross-int. 21. Then why isn't the outside line in Fig. 1 a circle?

Ans. It is, so far as it goes around the crank. In Fig. 4, a portion of the crank is hid by the connecting rod, which doesn't show the whole crank. In Fig. 1 it is designed to show the whole crank.

Cross-int. 22. Why is the outer circle completed in Fig. 4 and not in Fig. 1?

Ans. In Fig. 4, that outer circle may represent some part of the machine that is beyond, either the bearing that the shaft runs in or a circle in the gear. In Fig. 1, I suppose the section through *x x* was designed to run between the crank and the end of the bearing. In that case it wouldn't show a complete circle there.

Cross-int. 23. Isn't it perfectly clear that that large circle in Fig. 4 is a mistake in the drawing?

Ans. The specification says Fig. 4 represents a sectional elevation along the line of the machine, as cut off in Fig. 1. Now to know what that elevation is we must know how much has been cut off from that model, and it appears that that has not been cut off on a
150 straight line, but some portions have been cut off further back than others, and the drawing is a view of what there is left of the model after the portion cut off has been taken away. It is, therefore, necessary to examine the model to see what is represented in this figure. The upper side of the hub or large end of the crank is clearly seen at or near the circle, marked *m* in Fig. 4, and the whole figure appears to me to be a very correct representation of the model as it appears.

(Answer objected to by defendants' counsel as not responsive. Question repeated.)

Ans. It is not.

Cross-int. 24. Then what does it show, and why is it marked *m*?

Ans. That portion of the circle marked in dotted lines upon the connecting rod shows that the device is beyond the connecting rod. The portion marked in the full line above the connecting rod, and marked *m*, is where the crank appears in the model. The specification says the shaft *i* is provided with two cranks, *m*. That portion of the circle shown in the dotted lines between the crank shaft and the crank pin

may represent something beyond the crank. The pitch line of the pinion gear appears to be just this size, and it may represent that.

Cross-int. 25. Why is the crank shaft in Fig. 4 of nearly twice the diameter of the dotted circle in Fig. 1?

Ans. I don't know of any reason why it should appear so. On examination, it does not appear so.

Cross-int. 26. Do you mean to testify that the inner one of the two circles in Fig. 4 is not of a very much larger diameter than the dotted circle in Fig. 1?

Ans. The question was, was it not nearly twice as large? On examination, I find one a very little larger than the other.

Cross-int. 27. What are the sizes as you measure them?

Ans. The smaller one I find to be $\frac{7}{32}$ of an inch, the larger one less than $\frac{9}{32}$.

Cross-int. 28. Why is the but of the crank arm in Fig. 1 so much smaller than in Fig. 2?

Ans. I don't know of any reason. It is not a working drawing,
151 but it seems to me to be accurate enough to show any person skilled in the art of making meters how to make one.

Cross-int. 29. Why is the crank shaft shown in Fig. 1 as passing through the connecting rod?

Ans. It is not.

Cross-int. 30. Are you sure of this?

Ans. That is, as I understand it.

Cross-int. 31. Why is the crank shaft in Fig. 1 shown as lying between the crank arm and the piston rod?

Ans. Fig. 1 represents a vertical longitudinal section through x x, Fig. 2, and that is where such a view would locate the shaft.

Cross-int. 32. Why is the crank shaft shown without journals or bearings of any kind in all the figures or drawings of the reissue where the crank shaft is shown at all?

Ans. It is not, as I understand it.

Cross-int. 33. What bearings or journals for the crank shaft are shown in the drawings of the reissue? How are they lettered, if at all, and what is said about them in the description? State fully.

Ans. In the plan view, which is marked "Fig. 2," there is a drawing showing the outline of a bracket in the central portion of the meter supporting a sleeve or bearing. This view is very plain. Had the shaft, which runs through the sleeve, been represented by dotted lines, those lines might have come in the shading, so as not to have been seen. It seems to me that the drawing of this bracket is sufficiently plain, so that any person skilled in constructing machinery would understand this without any further description.

Cross-int. 34. Can you give no better answer to that question than you have done?

(Question reread.)

Ans. It seems to me that if any person skilled in the art of constructing machinery was told to locate a rotating shaft in any ordinary position, he would know enough to supply it with bearings without any definite instructions to do so, or exactly how to make them; if he didn't, I shouldn't think he could be called a competent or skilled mechanic in any branch of business; and, when there is a drawing showing a bracket or frame as plainly as this in Fig. 2, that it is amply sufficient for
152 the purposes of the patent without anything further being said about it. I believe there is no definite description or lettering of this bearing; neither do I think it is at all necessary that there should be.

Cross-int. 35. Look at the drawings of your original patent and also at the large copy Exhibit Duplicate Drawings and say whether you see any error whatever in those drawings.

Ans. I think they are substantially correct.

Cross-int. 36. Fig. 2 of those drawings is the same view of the meter as is meant to be shown in Fig. 1 of the reissue drawings; state why the shape of the slot was changed in Fig. 1 of the reissue drawings, and why the wrist pin was shown as not in the slot in that figure, and also explain, so far as you can, why Fig. 2 of the original drawings was altered, as shown in Fig. 1 of the reissue drawings.

(Objected to as misleading, Fig. 1 of the reissue not being the same as Fig. 2 of the original, Fig. 2 of the original being a section taken on the line *x y* of Fig. 1 of the original, looking towards the centre of the meter, while Fig. 1 of the reissue is a section taken on the line *x x* of Fig. 2 of the reissue looking from the centre of the meter, as testified by the witness in his direct examination. Question withdrawn, the defendants' counsel being satisfied that the complainants' counsel is substantially correct.)

Cross-int. 37. Compare Fig. 2 of the original with Fig. 1 of the reissue, and state why the shape of the slot was changed in Fig. 1 of the reissue, and why the wrist pin was shown as not in the slot in that figure. And also explain, as far as you can, why Fig. 1 of the reissue was substituted for Fig. 2 of the original.

Ans. I believe I have before stated that there appeared to be a mistake in this Fig. 1 of the reissue, the walls of the slot not being shown clear across the connecting rod, and also that the roll and wrist pin appear to be on the wrong side of the crank. How the mistake happened I cannot say. The slot and roll are shown in their proper position in Fig. 2 of the reissue, so that a person making a meter would readily see how the crank was designed to work.

Cross-int. 38. Why was so much more space left between the pe-
153 riphery of the friction roll and the walls of the slot at the bottom of Fig. 2 of the reissue than at the corresponding part of Fig. 1 of the original, Exhibit 1?

(Objected to because the duplicate of the original drawing which accompanies the patent is not the same in this respect as the Patent Office drawing annexed to Exhibit 1, and the reissue drawing appears to be the same in this regard as the duplicate drawing of the patent.

The defendants' counsel feels obliged to state that to him the Fig. 2 of the reissue is in this respect very widely different, not only from Fig. 1 of Exhibit 1, but also from Fig. 1 of Exhibit Duplicate Drawing, although the scale of the latter is much larger than that of the former.)

Ans. There appears to be a little difference in these two drawings, but it does not appear clear to me that it was intentionally made wider. It appears as though the draughtsman was not quite particular enough in showing that slot, as the lines which show the inside of the connecting rod extend clear to the crank pin; if these are correct it would show no play in the slot for the crank pin. I know of no reason why any change should be made; at any rate, it is not great enough to make any material difference in the operation of the machine, or mislead a person in constructing one.

Adjourned.

BOSTON, *March* 24, 1877.

Cross-int. 39. Doesn't that line you speak of, namely, across the lower front part of the slot at the bottom of Fig. 2 of the reissue, correctly represent the horizontal lower side of the rectangle of Fig. 1, suppos-

ing the upper part of the rectangle to be removed in order to show the widened part of the slot in Fig. 2? And answer also the same question as to the heavy line across the upper slot in Fig. 2.

Ans. I don't know that I have any evidence that any portion of the connecting rod has been removed to show what is below the surface. The description referring to this says that it is a plan. To suppose that a part of it has been removed, I don't see how the rest of the drawing could be explained or understood.

Cross-int. 40. Is it not clear from Figs. 1 and 4—Fig. 1 being a side view and Fig. 4 the other side view of the connecting rod—that
154 Fig. 2 is an edge view of the connecting rods, with the upper portion of each rectangular slot removed in order to show the wrist pin in the slot, and that the lines across the front part of the slot under the wrists correctly show the bottom of the rectangular slots shown in Figs. 1 and 4?

Ans. It does not. If the upper edge of the connecting rods were removed, as supposed, this (Fig. 2) then would not be a correct drawing of the connecting rods, as they would appear.

Cross-int. 41. It seems to me perfectly clear upon inspection that Figs. 1, 2, and 4 of the reissue drawings clearly show the piston rods with a rectangular slot in each, Fig. 1 being an inside view of the connecting rod and its slot, Fig. 4 an outside view it, and Fig. 2 an upper edge view of it, some of the upper part of the cross piece on the piston rod being omitted or broken away in order to show the wrists in the slots. This I shall insist upon at the argument, and as it seems to me to be a fatal defect in your reissue, I desire to give you an opportunity of saying any thing further you may desire to say about it.

(Counsel for complainants objects to counsel for defendants introducing his views into the question propounded to the witness, or any intimation as to his intention of propagating such views, which, according to the testimony of the witness, are entirely erroneous, the witness having testified that what the counsel calls rectangular slots are openings cut through the piston rods to show the position of the operating parts, and not the operating slots in the piston rods described in the patent.)

Ans. The description says, "Fig. 4 represents a sectional elevation along the line of the machine cut off in Fig. 1." This view of the drawing shows portions of both cylinders, both pistons, a portion of the connecting rod, a portion of the valve, a portion of one view of one crank, and several other important parts of the machine. Now, with a careful comparison of this Fig. 4 with the model now before me, cut away as indicated, with the exception of the unimportant matter of water passages on the bottom of the machine, I cannot see how it would be possible to make a much more clear and more accurate drawing and representation of the machine as it now appears before me. There is a rectangular opening through the connecting rod, as I have before
155 testified. This rectangular opening was made in the model to expose to plain view the crank as it passed its dead centre; this opening is shown in the drawing; the drawing would not be correct if it did not; and while there is nothing in this drawing to show that this rectangular opening is the slot referred to in the description as being the cam slots in which the crank rolls play, there is much to show that it is not; while in Fig. 2, the plan view, it is clearly shown that it is not.

In Fig. 2 these slots are shown open at the top, and no construction that I can conceive of can make them appear otherwise. I see that the lines showing the inside of the rods extend across the space between

the roll and the wall of the slot, but the space in the drawing is so very short that it takes very sharp eyes to see these points, even when pointed out. I don't believe that any person skilled in the art of making meters would ever notice these points at all or notice them as being anything more than a little carelessness in the drughtsman in putting down his pen. This plan view seems to me to be a very clear, full, and accurate drawing, and I believe it to be difficult to produce a better one or one freer from errors. In Fig. 1 there is an error, as I have before testified; the crank pin should be shown in dotted lines instead af full lines, the roll partly dotted lines instead of all full lines; the crank and crank pin otherwise than this error are correct, showing its position when passing a dead centre, and this figure would be of much service to a person making a meter in showing him that point, that is, to set the valve, the crank and the stop as the crank passes the dead centre. Another mistake in this figure is that the walls of the slot are not fully shown, but this mistake is not of a kind or magnitude that would mislead a mechanic in the least in making a machine; in fact, I think a mechanic would not have noticed it, but gone on and made his machine as shown and directed elsewhere, using this Fig. 1 to set his valve, crank and stop by, that being the principal purpose for which it is designed, and thus we have all the drawing that a person skilled in the art would ever need or use.

Cross-int. 42. It is also perfectly clear to me that in Fig. 2 of the reissue the crank shaft *i* is shown above and wholly disconnected from the four-sided piece which you have called a bracket, and this reading of Fig. 2 is made all the more clear by the reissue specification, where the crank shaft is said to be marked "*i*," and it is said that the shaft *i* is provided with two cranks, *m*. Do you desire to add anything in regard to this?

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Ans. This Fig. 2 is not designed to, neither can it, show the height of the crank shaft that is shown in Figs. 4 and 1. I don't believe a person skilled in the art of making meters would have one whit of doubt about the location of this shaft or any trouble at all in hanging it after looking over these drawings. I suppose they are not expected, neither does the law require, as I understand it, that these drawings and descriptions should be so definite, so full and clear, that a mechanic, even knowing nothing about meters, could understand how to make this meter; but a mechanic after knowing how to make the meter described in the Ball and Fitts patent of 1869, and other piston meters in which were cranks working in slots, like the Southerland patent of 1868, and understanding fully the operation of such meters, would really need one-half the amount of drawings and descriptions that is in this reissue patent to make a meter.

Cross-int. 43. There are two gear wheels shown in the drawing, one upon the crank shaft and the other upon the valve shaft or stem, by means of which the motion of the crank shaft is imparted to the valve. Can you point out any equivalents for these in the Desper meter?

Ans. I do not profess to be a mechanical expert, to state clearly what constitutes a mechanical equivalent in point of law; what I know is, motion is communicated from the two reciprocating pistons to the rotary valve by the crank shaft and crank pin working in the slots in the piston rods; and it seems to me that the minor devices which may be used to produce this result are not of so great consequence when the main object has been accomplished.

Cross-int. 44. How long have you made the stops on your meters in the way shown in Exhibit A?

(Objected to as immaterial.)

Ans. Question is not clear, and I don't understand what you mean.

Cross-int. 45. During what period of time have you used stops like those in Exhibit A on your meters?

(Same objection.)

157 Ans. The Union Water Meter Company, of Worcester, Mass., makes meters of different patterns. I have not made a meter throughout for a long time.

Cross-int. 46. For how long a time have the Union Water Meter Company used Exhibit A stops in their meters?

(Same objection.)

Ans. It is only a portion of the meters that they make in which they put in stops like those. I can't state how long it is since they made any.

Cross-int. 47. Haven't they made several thousands meters with stops like those in Exhibit A, and only a very few with the washer stop shown in your reissue?

(Same objection.)

Ans. I could not state what proportion. They have made several thousand meters with stops very similar to that in Exhibit A. Some years ago myself and a Mr. Ball secured a patent on a meter having stops on the connecting rod, of which that is a fair sample, Exhibit A. That patent was assigned to the Union Water Meter Company.

Cross-int. 48. The only use to which the stops in Exhibit A are put is to accurately determine the length of stroke of the pistons in order that the cranks and slots may act together to the best advantage; isn't that so?

(Same objection.)

Ans. No, sir; it is not.

Cross-int. 49. Mr. Waters seems to think that the Desper meter won't operate if one of the four pistons be drilled full of holes, as in Exhibit Piston. State whether it will operate or not under these circumstances.

(Counsel for complainants objects to the question.)

Ans. I never see one operate under those circumstances.

Cross int. 50. Don't you know perfectly well that the Desper meter will operate with holes through one of the four pistons and are you not well aware that the Desper meters are so constructed, and that the one you produced in this case, marked Davis No. 2, has holes through one of the pistons?

(Objected to as immaterial, and for the further reason that the
158 witness did not produce said exhibit, it being produced by the witness Davis.)

Ans. I am aware that meters will work with holes through their pistons. A meter made like either the Desper or the Ball and Fitts, with the exception with large holes through all the pistons and with the working parts all made very light and so as to move free and easy; such a meter would work to a considerable extent. How successfully the Desper meter would work with one piston cut away, as in Exhibit Piston, I am entirely unprepared and unable to say.

Cross-int. 51. Can you give any reason why the Desper meter should not work with holes through one of the pistons?

(Same objection.)

Ans. I have before stated that I am entirely unable and unprepared to say how successfully the Desper meter would work with one piston cut away, as in Exhibit Piston.

Cross-int. 52. Don't you know that the fluid cannot pass through the Desper meter with one of the pistons cut away, as in Exhibit Piston,

any otherwise than it can pass through it if that one of the pistons were not cut away?

(Same objection.)

Ans. No, sir.

Cross-int. 53. Will you swear that the water can pass through the Desper meter with three pistons and the fourth piston full of holes any differently from what it could pass through it with four pistons without holes in either?

(Same objection.)

Ans. I have said I was not prepared to state what the effect would be on cutting away this piston; but my opinion is, from what little thought I have given it, that it would pass through differently to some extent when this piston is cut away from what it would without being cut away, and that extent might amount to fifty per cent. of the stream of water being drawn through the meter, under certain circumstances.

BENAIAH FITTS.

Attest:

JOHN G. STETSON, *Examiner.*

159 *Second deposition of Hervey Waters.*

BOSTON, *March* 23, 1877.

Direct examination by ANDREW MCCALLUM, Esq., of counsel for complainants.

Int. 1. What is your name? You have previously testified in this cause, have you not?

Ans. Hervey Waters. I have.

Int. 2. Please examine the defendants' Exhibit Ball and Fitts 1869 Patent, and also complainants' Exhibit 4; describe what, if any, difference there is in the construction and operation of the devices therein shown and described, and also what, if any, difference there is in the results accomplished by said devices, in your opinion.

Ans. In complainants' Exhibit 4 the meter there described has piston rods with a cross slot, each piston rod working upon the wrist-pin of a crank, and each crank standing at right angles to the other, and the two operating together so that when the slot of the piston-rod is acting upon its crank in the most direct manner that crank is made to operate the valve for the other cylinder. There is no such device as this in the 1869 patent of Ball and Fitts. It will be obvious, upon inspection of the drawings in the patent, especially in Fig. 8, which represents the piston-rod of the 1869 patent, that the device there represented is essentially different from the piston-rod represented in Fig. 1 in the patent Exhibit 4, which is the reissue upon which this suit is brought. The slot in the piston-rod in the 1869 patent is parallel to the axial line of the piston-rod, while in the reissue of 1874, Exhibit 4, the slot is at right angles to that axial line. In the 1869 patent the shaft, upon which are the disks, works in the slot in one of the piston-rods, and there are upon each disk two pins which work into notches or gains in the piston-rod, first on one side and then on the other of the central line of the piston-rod, there being two of such notches on each side of the axial line of the piston-rod into which these pins work. Now, the patent of 1869 calls these pins cranks, and they would be cranks if they were organized to work as such, but they are not so organized as to act as

160 cranks in the 1869 patent, because there are two pins acting in

the same plane to receive motion from the piston-rod, which action of cranks cannot take place when there are two pins acting in the same plane and working into different notches or positions. The pins in the 1869 patent, which are called cranks in the patent, act as tappets, or rather the notches act as tappets, while in the reissue patent the wrist of the cranks act as cranks proper in the cross slots of the piston-rod. This difference is essential because, if for no other reason, the cranks working in the slots, when the machine is organized as described in Exhibit 4, are much easier to construct and reduce to practice, and much less likely to get out of order by use than in the organization of the 1869 patent, as appears to me. Moreover, I see no provision in the 1869 patent, in the organization of the machine there described, for adjusting the meter to change the amount of water passed through it at each revolution of the shaft or valve operated by the shaft, while there is such provision in the machine described in Exhibit 4, and besides the machine described in the 1869 patent does not seem to be capable of admitting of such adjustment.

Int. 3. Do you find in said Ball and Fitts 1869 patent the same, or substantially the same, combinations of devices which form the subject-matter of the claims of said reissued patent No. 5806, Exhibit 4?

(Objected to because the witness is not qualified to state what is claimed in the reissue.)

Ans. No; I do not. There are eight claims in this reissue, and there is entering into the combination recited and referred to in each of the claims a double-acting piston-rod, provided with a single slot, which slot is at right angles to the apis of the piston-rod, and into which works the wrist of a crank for operating the valve by means of this slot, wrist-pin, and crank; but there is no such contrivance in the 1869 patent, as I have before stated.

Int. 4. Have you examined defendants' Exhibit Ericsson Patent, and do you understand the operation and construction of the meters therein described? If so, please state particularly what difference, if any, there is between the meters described in said patent and the Ball
161 and Fitts meter, as shown and described in reissued patent No. 5806, complainants' Exhibit 4.

Ans. There are several meters described in the Ericsson patent inquired of, each of which has slide valves, while the valve in the meter described in the reissue inquired of has a rotary valve.

Some of the meters described in the Ericsson patent do not have piston-rods with a cross slot; one of the meters therein described has cross slots in the piston rods into which there works the wrist of a crank for operating the valves, which wrist is smaller in diameter than the breadth of slot in the piston-rod, substantially the same and for the same purpose as is done in the meter described in Exhibit 4, with the following exception, viz.: the slots in the Ericsson contrivance have parallel sides, while the slot described in the reissue, Exhibit 4, have cavities into which the wrist of the crank operates in certain contingencies.

The crank operated by the piston-rods in the Ericsson contrivance is connected with certain machinery, a good deal complicated, which is made to operate slide valves, while in the contrivance described in Exhibit 4 the rotary crank is made to rotate directly a rotary valve without any intermediate machinery other than a single pair of gears.

The Ericsson contrivance, with the cross slots in the piston-rods, has stops to stop the motion of the pistons without their being brought to rest by coming down on the wrist of the crank for that purpose, and,

in connection therewith, for the purpose or purposes referred to in the following quotation: "My invention in the above apparatus also consists in determining the range of motion of the pistons by means of stops at each end connected with the cylinders and pistons, instead of doing this by the cranks, by reason of which I am enabled to measure the fluid passing through with the utmost accuracy, a result which could not be obtained if the motions of the pistons were determined by the crank, for the least wear of either the crank-pin or the journals of the shaft, or the boxes in which these work, or the slightest change in the position of the cylinders relatively to the parts with which the pistons are connected, occasioned by strain or wear, would of necessity vary the amount of water discharged at each stroke."

162 Now I understand the purpose referred to in the above quotation to be to maintain the meter in its normal position or condition for the purpose of measurement, notwithstanding the wear of the parts connected with the cranks and valves.

But I understand the stops mentioned and described in reissue Exhibit 4 to have not only the purposes above described in the quotation, but also the purpose of adjustment, so that the meter, without being reconstructed in any way, can be adjusted to measure different quantities of water in proportion to the revolution of the valve, or, in other words, in proportion to the number of movements of the pistons, as occasion may require.

Int. 5. What difference in result, if any, is accomplished by the use of a single rotary valve, as in the Ball and Fitts reissue patent, complainants' Exhibit 4, instead of two slide valves, as in the Ericsson meter?

Ans. I think the most important difference is in the cost; the organization with the rotary valve is much the cheapest and altogether less likely to get out of order.

Int. 6. Do you find in the Ericsson specification any description or intimation or suggestion that the length of stroke of the piston can be altered or varied so as to discharge a greater or less quantity of water?

Ans. As a matter of adjustment, no.

Int. 7. Have you examined and do you understand the construction and operation of the meter shown and described in defendants' Exhibit Southerland Patent? If so, please compare the same with complainants' Exhibit 4, reissued patent No. 5806, and state what difference, if any, you find between them.

Ans. This Southerland meter inquired of is essentially different from the meter described in the reissue in the following features, viz: In the Southerland contrivance there are two valves where there is but one in the contrivance described in the reissue. These two valves in the Southerland contrivance are slide valves, while in the reissue the valve there described is rotary. In the Southerland contrivance the valves are worked by the piston-rods, while in the reissue it (the valve) is worked by the cranks. In the Southerland contrivance there are

163 cross slots in the piston-rods into which crank wrists work for the purpose of keeping the pistons in proper relation to each other; but these slots are not essentially wider than the diameter of the crank wrists which work in them; while in the meter described in the reissue the slots are essentially wider and for an essential purpose in that contrivance. In the Southerland contrivance there is nothing to stop the motions of the pistons except the wrist o f the crank, while in the meter described in the reissue the pistons are stopped independent of the crank. In the Southerland contrivance there are no means for adjusting the

stop of the piston so as to measure the different quantities of water at each movement of the machine, while there are such stops in the machine described in the reissue.

Int. 8. Have you examined and do you understand the construction and operation of the meter shown and described in defendants' Exhibit Spencer and Mayer Patent? If so, please compare the same with complainants' Exhibit 4, reissued patent No. 5806, and state what differences, if any, you find between them.

Ans. This Spencer and Mayer meter inquired of differs from the meter described in the reissue patent Exhibit 4 in the following essential particulars:

The valves in this Spencer and Mayer patent are slide valves, while in the meter described in Exhibit 4 the valves are rotary.

This rotary valve in the Exhibit 4 is worked directly by the crank, while in the Spencer and Mayer meter the crank works two eccentrics, which operate the two slide valves after the manner of a steam-engine.

The cranks which work the eccentrics are worked by the piston-rods in the meter in the Spencer and Mayer contrivance, said piston-rods having cross slots or slots at right angles to the direction of the movement of the piston, but these slots are not essentially wider than the diameter of the crank-pins, while in the contrivance described in the reissue Exhibit 4 the slots are essentially wider than the crank-pins and for an essential purpose.

There are no adjusting or adjustable stops in this Spencer and Mayer meter, nor are there any stops other than the wrist-pins of the cranks, while there are such stops in the machine described in the reissue
164 Exhibit 4, which not only stop the pistons independently of the crank-pins, so as to relieve the crank-pins from the strain, but they are adjustable, so that the machine can be adjusted to stop the pistons at different positions, and thereby cause the machine to measure out different quantities of water at each revolution of the machine as circumstances may require.

Moreover, the Spencer and Mayer meter is not so constructed as to admit of the use of such adjustable stops as I have said were found in the meter described in the reissue Exhibit 4.

Int. 9. Same question repeated as to Exhibit Barden Patent.

Ans. In this contrivance of Barden, described in the patent inquired of, the piston-rods connecting the pistons of each of the pair working in the cylinders are straight rods, having no slots through them in any direction, while in the machine described in the reissue the piston-rods have slots across them, working their valves in a peculiar manner by means of a crank; and this is an essential difference in the two machines.

In this Barden contrivance there are connecting rods attached to the pistons, which work cranks after the manner of a common steam-engine, and these cranks operate the valves by means of cams upon the crank-shaft, the valves being slide valves in this Barden contrivance, while in the contrivance described in the reissue Exhibit 4 the valve is rotary.

There are no stops in this Barden contrivance, either adjustable or otherwise, for stopping the pistons at the end of their strokes, other than the cranks and their connecting rods, nor is the Barden meter so constructed as to admit of stops to vary the measuring capacity of the machine, as is done in the meter described in the reissue Exhibit 4.

Int. 10. Have you examined and do you understand the construction

and operation of the meter shown and described in defendants' Exhibit Desper Patent? If so, please compare the same with complainants' Exhibit 4, the reissue patent 5806, and state what similarities or differences you find.

Ans. I understand the contrivance described in the patent to Desper inquired of, I believe.

In my former direct examination in this case I went at length into a comparison of Exhibit 6 with the machine described in the
165 reissue Exhibit 4, now inquired of. Now this machine, Exhibit 6, seems to me to be the same as the machine described in the patent to Desper in all essential particulars save one, or perhaps, in connection with that one, another essential particular in these meters.

In the patent to Desper inquired of, the cross-slot in the piston-rod is represented as being substantially of the same size as the wrist-pin of the crank. Therefore, it will be readily seen that the meter described in the patent to Desper cannot be adjusted by means of stops, so as to vary, to any essential degree, the amount of water which must pass through that meter at each revolution. I am aware that something is said about such stops in the patent, and particularly in the following words:

"The set screws *k*, through the cylinder heads, as above referred to, afford adjustable abutments for stopping the pistons at the outer terminations of their strokes at such points as will allow them to discharge the proper amount of water."

Now, no such adjustment can take place in this meter to any appreciable extent, because the cranks must rotate; and if they do rotate in these slots, which are substantially the same size as the wrist-pins, then the cylinders must make a given length of stroke to every revolution of the crank, which cannot be essentially varied by any stop without stopping the revolution of the crank.

Int. 11. How are the slots in Exhibit 6 as compared with the slots shown in the Desper patent?

Ans. They are wider than the diameter of the crank-pins, as I stated fully in my first direct examination in this case.

Int. 12. Please look at the drawings of Exhibit 4, and state whether or not you find any difficulty in understanding the same, and whether or not you could construct a meter from the same.

Ans. I see no essential difficulty with the drawings inquired of when examined in the light of the description contained in the body of the patent, and I think that, taken altogether, there would be no difficulty in constructing the machine from the description in the patent.

Int. 13. Please look again at defendants' Exhibit Ball and Fitts 1869 Patent, and state whether or not, with said patent before you, taken
166 in connection with Exhibit 4, you could construct the valve and arrange it so as to operate with the other devices shown and described in said Exhibit 4.

Ans. Certainly, I could.

Cross-examination by JAMES E. MAYNADIER, Esq., of counsel for defendants.

Cross int. 14. Do you believe that there is any description in the original Ball and Fitts Patent, No. 109372, of any combination of a crank shaft with two cranks, one at right angles to the other, double-acting piston-rods with slots across them and stops, the slots so much wider than the diameter of the wrist-pins of the cranks as to admit of the stroke of the piston being varied practically by the stops, and for the

purpose of varying the quantity of water discharged, to any practical extent?

Ans. Yes, I know there is. It will be seen on an examination of what I understand to be a copy of the drawings attached to the original patent inquired of (a copy of which on a smaller scale is attached to Exhibit 1) that the crank-pin shown at Fig. 2 of the drawings is about fifteen thirty-seconds ($\frac{15}{32}$) of an inch in diameter, while the slot at its narrowest point is something more than seventeen thirty-seconds ($\frac{17}{32}$) of an inch in diameter, and measuring that slot at its central portion, which is in the axis of the piston-rod, it measures something more than nineteen thirty-seconds ($\frac{19}{32}$) of an inch in breadth. Now, it appears from this that a meter constructed of the size of Exhibit 6, which is somewhat larger than the drawings referred to (the cylinder in Exhibit 6 being something more than eight inches long, while the drawing represents the cylinder as something less than six inches long), would have its slot wider than the diameter of the wrist-pin by about five thirty-seconds of an inch. This would allow of a material adjustment of the length of the stroke of the cylinder by means of the stops described in the patent.

Going now to the matter of the cranks at right angles, and referring to Fig. 1 of the drawings, it will be seen that one of the cranks is shown as standing nearly at right angles, if not quite, to the other, but going to the letter-press of the original patent inquired of, I find these words:

167 "As the water flows in and moves the piston, it will be seen that by the peculiar form of slot *e* the piston reaches the end of the stroke and stops a little before the crank passes the centre (shown by the position on Fig. 2) or the valve ports quite close. The opposite piston then moves the valve over and opens it to the other side of the piston before the crank-pin reaches the point to where the first piston would be compelled to move, and thus in no case would one piston force the other to move while its valve is closed."

Now, any person reading this and understanding it clearly could have no difficulty in understanding that for the purposes therein set forth the cranks must stand substantially at right angles; and that, taken in connection with the drawings, would be sufficient to teach a person skilled in these matters, not only that the cranks must stand substantially at right angles, but that the slot must be wider than the wrist-pin in order to allow of the adjustment of the stops so as to vary the length of the strokes of the piston.

Cross-int. 15. It is certain, isn't it, that unless the slots at their narrowest portions be of a width practically in excess of the diameter of the wrist-pins, the stops can perform no other function than that of adjusting the length of stroke to suit the length of the crank arm?

Ans. No; I don't so understand the machine.

Cross-int. 16. What function do the adjusting stops in Exhibit A perform?

(Objected to as immaterial, Exhibit A not being one of the meters in suit or constructed in accordance with the patent in suit.)

Ans. As the stops are now adjusted in Exhibit A, they stop the piston short of the position at which they would arrive if the stops were moved, I believe; not so much as they might do, quite, I believe, but some short.

Cross-int. 17. Point out everything which you think you find in the specification of patent No. 109372 which describes or suggests or sub-

stantially indicates the invention described in the fourth claim of the reissue 5806.

Ans. I find described in the patent, No. 109372, inquired of, a water meter, called in the fourth claim inquired of a liquid meter, in which
168 are embodied a rotary valve in the claim inquired of, provided with suitable ports or openings, through which the liquid to be measured is supplied to the meter and discharged therefrom, two cylinders *b* and *b*^{1}, referred to in the claim inquired of, for the reception and measurment of the liquid, the double-acting pistons *c* and *c*^{1}, referred to in the claim inquired of, each carrying a rod, *v*, referred to in the claim, and each of these rods provided with a single cam slot, *e*, referred to in the claim, arranged as described, each of those cam slots being of a width greater than the diameter of the wrist *n* of the crank referred to, so as to admit of the adjustment of the pistons that they may discharge at each stroke, as nearly as possible, the exact quantity of water required, and so as to allow each of the crank wrists *n* freely to pass its dead centre after its own piston has ceased to act on it, as referred to in the claim inquired of, adjusting stops *o*, referred to in the claim inquired of, by means of which the adjustment of the length of the stroke of the pistons at either end is effected, and also the crank-shaft *i*, referred to in the claim inquired of, through which motion from the pistons is imparted to the valve, the whole being combined and operating together substantially as described in the reissue. All these parts I find in the original patent, No. 109372. There is some difference in the description in the two cases—I mean in the patent 109372 and the reissue—but I do not find anything referred to in the claim that is not found in the original patent that I am now able to discover, so far as is referred to in the fourth claim of the reissue.

Cross-int. 18. Do you think you find anything in patent 109372 which describes, suggests, or indicates in any manner that the slots across the rods are to be any wider in proportion to the diameter of the wrist-pins, except by reason of the "concavities," than is usual when slots and wrist-pins are used? If so, state fully what you find.

Ans. Yes. I have already said that the drawings represented the slots as wider than the wrist-pins, not only in the middle, but at the ends.

The patent says among other things:

"*e* is a slot in the connecting rods. It will be seen that the sides of this slot are not parallel or straight, the slots being wider in the middle than at the ends."

169 And on reference to the drawings we see that they are not only wider in the middle of the slots than the diameter of the wrist-pin, but also at the ends.

Moreover, the first claim of the original patent claims the piston-carrying connecting rods *d*, having slots formed as shown, with concavities to the right and left of the centre, in combination with the slots *o o*, substantially as set forth, and operating as described. Now the slots, as I have already said, formed as shown, not only have concavities at the right and left of the centre, but the slots are wider, where those concavities do not exist, than the wrist-pin which works in the slots, just the same and for the same purposes as they are described in the reissue. I don't mean to say that the description is the same, but the slots are the same in the one case as in the other, because in both patents, the original and the reissue, the drawings are the same.

Cross-int. 19. Is that all?

Ans. No; I think the paragraph previously quoted from the patent

109372, describing the operation of the machine, indicates that the slots are wider than the wrist-pins, independent of the concavities, because if they were not wider, except where the concavities are, there could be very little adjustment by the stops, especially if each concavity was upon one side of the axis of the piston-rod. The original drawing, at Fig. 2, represents one concavity as almost wholly upon one side of the axis of the piston-rod, and the other as lapping over beyond the axis upon both sides.

The claim in the original patent refers to the slots with concavities to the right and left of the centre, but the patent says, "*e* is a slot in the connecting rods. It will be seen that the sides of this slot are not parallel or straight, the slots being wider in the middle than at the ends." Now, the slots cannot be wider in the middle than at the ends if the concavities are at the right and left of the centre, because the straight side of the slot upon one side of axis will come down to the axis, and so it will upon the other side of the slot, and in that case a wrist-pin cannot pass between them at the axis, which is bigger than the ends of the slot, nor can the wrist-pin pass those points except the piston-rod makes a stroke equal to the sweep of the crank, any more than
170 could be done if the parallelism of the sides of the slots extended away through and without the concavities. And taking the whole of the original patent together, I should say that the description calls for the concavities to be placed substantially as indicated upon the left-hand side of the crank-pin in the drawing Fig. 2, rather than as indicated upon the right-hand side of the same figure.

Cross-int. 20. Is there anything more?

Ans. I don't think of anything else.

Cross-int. 21. Do you think you find anything in that patent, No. 109372, which teaches you or suggests or indicates to you that the stops are adjustable? If so, what?

Ans. I don't see anything in the patent which says the stops are adjustable, nor anything which indicates it other than in the quotation which I have already made from the patent.

I notice, with reference to Fig. 2 of the drawings No. 109372, that what seems to be represented as a screw at *o* upon the right hand of the drawing, has a collar under the head, which stands at a little distance away from the piston-head, while the screw at the opposite end has the collar brought up to the piston head. That is a slight indication in the drawings that the screws which act as stops are adjustable.

Cross-int. 22. Did you notice at the place you refer to in Fig. 2 of the original drawings that the shading of the spindle between the collar and piston head shows that it is not a screw but a plain spindle, so far as it shows anything at all about it?

Ans. No, I did not; but I noticed that it didn't show that it was a screw.

Cross-int. 23. I find in the original patent, No. 109372, a pretty fair description of the stops *o o*, to this effect, that they areto prevent the slots bringing up against the wrist-pins when the cranks are near their dead centres. Can you find any description of any other purpose of these stops than this; if so, what?

Ans. I have already stated what description I did find for the purposes of adjustment, and have nothing more to add to it, so long as the inquiry relates to the original patent only and without any reference to the model filed with the original patent, a certified duplicate of which from the Patent Office I have before me.

171 Cross-int. 24. I can't find anything whatever in the original pat-

ent which even so much as alludes to any adjustment of the meter for the purpose of varying the quantity of water registered; can you?

Ans. I have nothing to add at present to what I have stated upon that subject so long as the inquiry is confined to the original patent, No. 109372.

Adjourned.

MARCH 24, 1877.

Cross-int. 25. Do you believe that the combination described in the first clause of claim in the reissue (taken, of course, in connection with the preceding parts of the specification) is operative for any purpose?

Ans. Yes, I think it was operative when taken in connection with other parts of the machine described in the patent, and I think it would be operative when taken in connection with other parts which were in fact equivalent to other parts of the machine described in the patent, but I do not think it would be operative with simply the parts referred to in the first clause of claim and there mentioned or recited in detail. For instance, only one cylinder is specifically referred to with its pistons; now, it is evident that a single cylinder and its accompanying pistons could not operate as the machine is described to operate in the patent, because one cylinder works the valve of the other cylinder, and therefore it is obvious that either the other cylinder or its equivalent must be there in order to work the valve of the cylinder which is there and specified in the first claim.

I wish to be understood, however, as not undertaking to state what the legal scope of the claim is, but simply as stating what is specifically stated and designated by the letters of reference.

Cross-int. 26. Do you think that two pistons are essential to make the combination specifically referred to in the first clause of claim?

Ans. Yes, I do. I understand the claim to specifically refer to two cylinders with their two pistons, when considering the fact that there are really in the machine described in the patent four cylinders and four pistons, because, in the first place, there are four pistons
172 and four cylinders in the machine as described in the patent.

Taking now the language of the claim, I find it as follows: "A cylinder, *b* or *b'*, for the reception and measurement of the liquid, and a double-acting piston, *c* or *c'*, carrying a rod, *d*," etc. Going now to the drawings of the reissue, I find that the drawings of the reissue, at Fig. 2 of Sheet 1, represent two cylinders marked *b'*, and turning to Fig. 4 of Sheet 2 I find the same thing, so that the claim refers to two cylinders, although it speaks of the two as one; and I find that the pistons are marked in a similar way, and it is evident that where the claim refers to *c* or *c'* as alternatives, it refers to two pistons, as appears from the drawings, and, besides, the claim says the piston is "double-acting," and that it "carries a rod." Now unless there were two pistons upon that rod, in fact, the pistons could not be "double-acting," because the water acts upon one side only of either of these pistons.

Cross-int. 27. Suppose that one of the four pistons of the meter described in the reissue had a series of holes bored through it as in Exhibit Piston, would not the water run through the meter without being registered?

(Objected to as immaterial.)

Ans. I am sure I don't know where it could run to, whether through the meter or not; it would run through the piston undoubtedly, and would not move the meter by that piston, and therefore there would be no registering by that piston.

Cross int. 28. Would the reissue meter register or not if one of the four pistons was full of holes as supposed?

(Same objection.)

Ans. The first answer to that is, that it would not be the reissue meter if it was so bored; the next is, if it was so bored it would not be a meter at all, because it would not make a revolution of the machine at all; or, in other words, it would be entirely inoperative, and therefore it could not register for any practical purpose.

Cross-int. 29. Now suppose that one of the four pistons in the Desper meter were bored through in the same way, would not the fluid which passed through the meter thus altered compel the pistons to reciprocate, and thereby revolve the valve as before?

(Same objection.)

173 Ans. I don't see how it would.

Cross-int. 30. Do you testify that it will not?

Ans. No.

Cross-int. 31. You have not believed, in the testimony you have given in this case, that the two cross-slots which form one of the ingredients of the combination specifically described in second clause of claim, should be slots whose width is considerably more in excess of the diameter of the friction-rolls on the wrist-pins than is usual in the well-known mechanical contrivance of a crank moved by a slot, have you?

Ans. Certainly, I have. I don't believe that my testimony in this case, in regard to this point, can be misunderstood, especially that part wherein I compared the machine described in the Southerland patent, 78551, with the reissue patent, Exhibit No. 4.

Cross-int. 32. Suppose a meter constructed precisely like Exhibit 5, with these two exceptions only, namely: first, that both slots were of equal width throughout, and at that width bore the same relation to the diameter of the wrist-pins as is usual when wrist-pins work in slots; and, secondly, that the adjusting stops attached to the pistons were removed, and state whether this meter would or would not embody the combination specifically described in second clause of the reissue, in your opinion.

Ans. I think it would not.

Cross-int. 33. Would it not have (1) a rotary valve, (2) two cylinders (or four, if you choose to call them so), (3) two double-acting pistons (or four, if you choose to call them so), (4) two piston-rods, (5) two slots, one across each rod, and (6) a crank-shaft, *i*, and would not each one of these parts be substantially the same as the corresponding part mentioned in the second claim of the reissue? If not, how would they differ? State in detail.

Ans. In answer to the first clause of the question, I say yes; in answer to the second, I say no. The two piston-rods with their cross-slots working in connection with the wrist-pins in your hypothetical machine, would be substantially different from the two piston-rods with their cross-slots working in connection with their wrist-pins in the machine described in the reissue.

174 Cross int. 34. Is not the crank-shaft in the Ericsson patent the equivalent of the crank-shaft *i* in the reissue?

Ans. Yes, it is for one of its purposes, that is, for carrying and supporting its crank, and perhaps for another, and that is, for the purpose of conveying motion to some other thing.

Cross-int. 35. Here we agree exactly. I find a crank-shaft, *i*, in the reissue and a crank-shaft, in the Ericsson, both of which support the cranks and are revolved by the cranks, and to both of which is con-

nected some other thing, by means of which other thing the valves are moved in the Ericsson and the valve is moved in the reissue. But I also find in the Desper meter, by reason of radical differences in construction, that this crank-shaft *i* of the reissue and that "other thing" which you speak of are eliminated from the combination, and that in lieu of this crank-shaft *i* and its two cranks, a wrist-pin connected directly with the valve-stem, or, if you prefer another form of expression, that the valve is placed directly upon a crank-shaft, this shaft forming a part of the valve. Do you agree with me in whole or in part? If so, please say to what extent, and also point out as clearly as possible what part of the Desper meter you consider the equivalent of the crank-shaft *i* of the reissue, what of the two crank-arms of the reissue, and what of the two gears of the reissue by means of which the crank-shaft operates the valve.

Ans. In reply to this cross int. 35, I wish to state first that I hardly know where mere assertion leaves off and the interrogatory begins; but it appears to me that the first question is whether I agree with the counsel, whole or in part, as to the assertions of counsel made in connection with the question. I believe I may say I agree in part, but not in the whole of the assertions.

If I understand what the counsel asserts, it is, among other things, that the crank-shaft found in the Ericsson patent works the same thing as the crank-shaft found in the reissue. I do not agree to this, because the crank-shaft in the Ericsson machine works an eccentric, which eccentric works a connecting rod, which connecting rods works a slide-valve, while the crank shaft in the reissue works another shaft by means of a pair of gears, which other shaft works a rotary valve directly in connection with itself.

Another assertion made by the counsel is that he finds in the
175 Desper meter, by reason of radical differences in construction, that this crank-shaft *i* of the reissue and that other thing which you (meaning me) speak of, are eliminated from the combination, and that, in lieu of this crank-shaft *i* and its two cranks, a wrist-pin is connected directly with the valve-stem; or, if you (meaning me) prefer another form of expression, that the valve is placed directly upon a crank-shaft, this shaft forming a part of the valve. Now, I don't agree to all of this; with much of it I do agree; and perhaps in so much as I do agree and in so much as I do not will fully appear in the answer which I shall give to another question.

The other question refers to the infringement, of which I have spoken at length in my first direct examination in this case, and which will be found upon pp. 38 and 39 of the printed record, to which I now refer as a part of the answer proper to be given to this question, and I supplement what is there found with what follows.

I consider the shaft with the crank and wrist-pin upon it, found in defendants' Exhibit B, to be the equivalent of the crank-shaft *i* of the reissue. This crank-shaft in Exhibit B has upon it not only the crank, but also the valve working in connection with the valve-seats in the Desper contrivance. I consider the crank upon this shaft, with its long pin or wrist working in the slots of the two piston-rods which stand at right angles to each other in the Desper contrivance, as the equivalent of the two cranks with their wrist-pins standing at right angles to each other upon the shaft and working in the slots of the two connecting rods which stand parallel to each other.

I consider the direct connection of the crank-shaft with the valve in the Desper patent as the equivalent of the connection made by the pair

of gears in the reissue, which are merely for the purpose of transferring motion from the crank-shaft to the shaft of the rotary valve, because it is only neceesary, to make that direct connection, to place the axis of the shaft upon which the valve works in a line with the axis of the shaft on which the crank works, and to make it part of that shaft, and to so modify the rotary valve as to admit of its making more revolutions or a greater proportion of a revolution to each movement of the piston, neither of which, nor both together, involve any invention.

176 Cross-int. 36. It seems to me very clear that the real invention described in the reissue is an improvement upon the Ericsson meter, consisting in removing the eccentrics from the crank-shaft of that meter and dispensing with the slide-valves and the connecting rods connecting them with these eccentrics, and instead of these eccentrics, connecting rods, and slide-valves substituting the rotary valve of the Ball and Fitts 1869 patent with the two gears, one upon the crank-shaft and the other upon the valve-shaft, also shown in the Ball and Fitts 1869 patent, or, in other words, that the only invention embodied in the meter described in the reissue is a substitution of the two gears and the rotary valve of the Ball and Fitts 1869 patent for the eccentrics, connecting rods, and slide-valves of the Ericsson patent; or, from a different point of view, the substitution of the Ericsson piston-rods and cross-slots for the piston-rods of the Ball and Fitts 1869 patent and the Ericsson crank-shaft with its two cranks for the shaft, disk, and pins of the Ball and Fitts 1869 patent. Please consider these assertions, and state whether you agree with them in whole or in part, and to what extent, if any.

Ans. I don't agree with them in any part when taken, if it is to be taken, as a statement of the invention described in the reissue upon which this suit is brought.

Cross-int. 37. You have said something to the effect that the only function of the two gears was to impart motion from the crank-shaft to the valve-shaft. Please state now whether these gears must not have a definite relation to each other, to the two shafts upon which they are respectively mounted, and to the valve and its seat, these relations depending primarily upon the construction of the ports in the valve and valve-seat?

Ans. It is undoubtedly true that if the valve makes only one revolution to two of the crank-shaft, that the valve will require to be differently constructed as to the arrangement of the ports in the two parts of the valve, from what will be required if the valve makes the same number of revolutions as the crank-shaft, but this does not involve any new function; the only function of the gears is to drive the valve-shaft round. This will be obvious when we consider that, if the gears described in the reissue, to which the question refers, were of equal size, then the valve would have to be modified just the same as

177 the valve would have to be modified if the valve be placed immediately upon the crank-shaft in the reissue, and the gears were dispensed with.

In this last supposed case it would, of course, be necessary to change the arrangement of the valve-seat, because the shaft upon which the valve works in one case would be at right angles with the shaft upon which the valve would work in the other case; but this difference does not involve any invention.

Going back now to the supposed case of the two bevel gears of equal size in the reissue, and comparing that with the two bevel gears of unequal size in the reissue, it is obvious that the function of the gears would be the same in each machine, whether they have more than one

function, or whether they do not; and it may be proper to say that another function of the gears is to keep the valve in proper relation to the cranks; but just here, and for the purposes of a proper understanding of this case, it should be understood that, if the valve were mounted directly upon the crank-shaft, as I have supposed in one instance, and as is done in this contrivance of Desper, then the shaft itself would perform the function of keeping the valve in proper relation to the cranks, which would be done by the gears where I have supposed the gears to be of equal size.

Cross-int. 38. Is it not clear to you that Fig. 1 of the reissue shows an inside view, Fig. 2 an edge view, and Fig. 4 an outside view of the connecting rod?

Ans. No.

Cross-int. 39. What do you believe to be the purpose of the irregular form of the bevel gear on the valve, as shown in Fig. 2 of the reissue?

Ans. I don't believe it was done for any purpose. I believe it was simply carelessness or simply inartistic.

Cross int. 40. Is it not clear to you from the reissue drawings that the crank *m*, at the upper part of Fig. 2, is formed with a hub of the same diameter as the shaft *i*, with a cylindrical stud projecting from that hub and entering a socket bored in the end of the crank-shaft *i*, the stud being indicated by the dotted circle marked "*i*" in Fig. 1; or, in
178 other words, do not these drawings show that one of the cranks is connected to the crank-shaft by forcing a stud, projecting from a hub on the crank, into a hole in the end of the crank-shaft, concentric with the axis of the crank-shaft?

Ans. No, to both questions.

Direct examination resumed:

Int. 41. You stated in your cross-examination that you did not find a description of the adjusting stops or the adjustable feature of the stops in the Ball and Fitts patent, No. 109372, Exhibit 1. Please examine the Patent Office duplicate of the model belonging to said patent now shown you, and state whether or not you find these adjustable stops as forming a part of said model. If you do find them, describe how they are made, and whether or not the corresponding parts are shown by the drawings of said original patent, Exhibit 1, and by the reissue of the same, Exhibit 4, and if there is any difference between the original and reissue in this respect.

(Objected to as wholly immaterial, and also because exhibit duplicate model is not competent evidence of anything.)

Ans. There are adjustable stops in the duplicate model inquired of, the same consisting of screws in the ends or central faces of the pistons, the heads of which screws butt against the cylinder heads, stopping the motions of the pistons within longer or shorter limits, according to the position at which the screws are adjusted. These screws are represented at *o o o o* in the original patent, and the same are shown in the reissue.

HERVEY WATERS.

Attest:

JOHN G. STETSON, *Examiner.*

179 EVIDENCE FOR COMPLAINANTS IN REPLY.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States, in equity, as amended, before me.

P. B. STILSON,
U. S. Commissioner.

Deposition of Edward W. Donn.

WASHINGTON, D. C., *April* 9, 1877.

Direct examination on interrogatories by ANDREW MCCALLUM, Esq., of counsel for complainants.

Int. 1. State your name, age, residence, and occupation.

Ans. Edward W. Donn; age, 40; Washington, D. C.; draughtsman.

Int. 2. How long have you been engaged in the business of draughtsman, and how and where were you employed in the year 1874?

Ans. I have been a draughtsman about eighteen years; was chief draughtsman in the United States Patent Office in 1874, and had been for some years previous.

Int. 3. Did you make, or cause to be made, the drawings for and which accompany reissued letters patent No. 5086, granted to the Union Water Meter Company, assignees of Messrs. Ball and Fitts, March 24, 1874?

Ans. I made the drawings for said reissue while chief draughtsman of the Patent Office.

Int. 4. Please state from what said drawings were made, and whether or not they represent the model in the United States Patent Office which accompanied the application of said Ball and Fitts for letters patent No. 109,372, of November 22, 1870; and if there is any variation or mistake in said drawings, state particularly what it is.

Ans. The drawings I made from the model and drawings in the office that were filed with the application for letters patent No. 109,372.

180 They generally represent the machine in question, although I find on examination a few inaccuracies. The model from which the drawings were made was a very heavy and clumsy one, and for that reason I undertook to make sketches at the office from it, and finish from memory at home. Figure 1 was shown principally to represent the stops that limit the motion of the piston, and there was no special line indicated from which said section was taken, but in a general way I showed the rod connecting the pistons from the opening cut away in said model. I notice a part of the crank shown in full lines when it should have been shown in dotted lines; that is, the part that falls outside of the slot in the connecting rod. The full form of the slot I did not show in Figure 1. In Figure 2, the plan view, I find slight errors, as follows: The inner line of slot *e* is shown as though there was a substance crossing at the bottom, when, in reality, the slot is open all the way through. The outer line of the bevel-wheel *r*, which should be a circle, is shown as an irregular, curved line. These drawings were made for the Patent Office, and such are not required to be as accurate as working drawings; they are merely for the purpose of illustration, and these drawings appear to answer the purpose. In Fig. 2 the broken and dotted lines marked *x*—*x* are merely taken to indicate where the section was taken through the casing, and not through the operating parts. Fig. 1 of the drawings represents a sectional view of the model, and Fig. 2 a plan view of the same. Fig. 3 is a section in a plane at right angles to the plane of Fig. 1; and Fig. 4 is a sectional view, showing the meter as cut away in the model.

Cross-interrogatories propounded by J. E. MAYNARDIER, esq., of counsel for defendants.

Cross-int. 5. Does not Fig. 1 show the inner side of the connecting

rod? If you think it does not, explain fully and in detail why you think so.

Ans. I did not so intend it. If I had intended to show the inside of the connecting rod, I should have shown the shaft and the sleeve surrounding the shaft and supporting the same in section. As before stated, this figure was intended more particularly to show the stops and merely indicate the position of the crank. It is a view of the outside of the rod rather than of the inside.

181 Cross-int. 6. Does not Fig. 4 show the outer side of the connecting rod? If you think it does not, explain fully in detail why you think so.

Ans. It does; portions being cut away to show the position of the crank-pin, bevel-wheel, etc., and also one of the screws of the stops.

Cross-int. 7. What do the two concentric circles marked *m* in Fig. 4 represent? State fully, and explain clearly.

Ans. The inner one represents the crank-shaft: the outer one represents the contour of the crank, as well as the outline of the sleeve surrounding the crank-shaft.

Cross-int. 8. Why was the heavy shade line on the inner side of the upper connecting rod, as shown in Fig. 2, drawn clear across the slot?

Ans. This was an error, or slip of the pen. The line should have been omitted so as to show a clear space through the slot.

Cross-int. 9. Why was a line drawn clear across the inner side of the slot, in the lower connecting rod shown in Fig. 2?

Ans. This also was an error as in first case, the upper one.

Cross-int. 10. Why was the slot shown as rectangular in Fig. 1?

Ans. The slot is not shown at all in Fig. 1; the rectangular lines merely show the opening through the connecting rod.

Cross-int. 11. What does the dotted circle marked in Fig. 1 represent? State fully and explain clearly.

Ans. It indicates the position of the end of the crank-shaft.

Cross-int. 12. What is the purpose of the peculiar shape of the bevel gear *r*? State fully and explain clearly.

Ans. The bevel gear *r*, as I before stated, has its outline drawn wrong. It should have been a circle instead of an irregular curved line.

Cross-int. 13. What means of supporting the crank-shaft *i* are shown in the drawing? State fully and explain clearly.

Ans. The crank shaft finds its support in the sleeve which surrounds the shaft *i*, and which forms part of the frame shown in the plan view over the valve.

182 Cross-int. 14. Why is the wrist-pin and its friction-roll shown in Fig. 1 as extended towards the middle of the meter instead of away from the middle, as in Figs. 2 and 4?

Ans. It does not appear to me to be so shown. As before stated, the figure is merely intended to indicate the relative positions of the stops, pistons, and rod, the position of the crank and pin being incidentally indicated.

Cross-int. 15. Why are the cylinders in Fig. 1 larger than those in Fig. 3? Explain fully.

Ans. There was no intention of making these cylinders different in the two views, the drawings not being made to a scale like working drawings.

Cross-int. 16. Does not the tracing now shown you (now put in evidence and marked Exhibit Tracing, with the initials of the commissioner), correctly show the large bevel gear marked *r* in Fig. 2? If not, wherein is it incorrect? State fully.

Ans. The tracing is substantially the same as the bevel gear shown by Fig. 2; but, as before stated, it is not a correct view of the wheel. It should have been circular, like all other wheels. It is simply an inaccuracy in the drawing.

Cross-int. 17. Does not Fig. 5, on the drawing now shown you (now put in evidence and marked Exhibit Additional Drawing), correctly show the manner in which the upper crank in Fig. 2 is attached to the crank-shaft *i*? If not, state fully and explain clearly why not; and in course of your answer explain fully your reasons for denying that the line between the hub of the crank-arm *m* and shaft *i* in Fig. 2, and the small dotted circle marked *i* in Fig. 1, together indicate that the upper crank-arm *m* of Fig. 2 is formed with the hub, and a stud projecting from that hub, as shown in Fig. 5 of Exhibit Additional Drawing.

Ans. The drawing Exhibit Additional Drawing, Fig. 5, does not correctly show the crank-shaft and sleeve surrounding it, inasmuch as the crank-shaft in the machine passes entirely through the sleeve, and has cranks at either end of it, while Fig. 5, Exhibit Additional Drawing, shows no shaft passing through the sleeve, but simply a stud projecting from crank *m*. The line between the hub and the crank-arm *m* in Fig. 2 simply shows the division between the hub of the crank and the
183 sleeve which surrounds the shaft. The small dotted circle *i*, shown

(Here follow 2 diagrams marked page 182.)

in Fig. 1 indicates the position of the shaft. They are not formed with a hub, and a stud projecting from that hub, as shown in Fig. 5, Exhibit Additional Drawing.

Cross-int. 18. Does not Fig. 6 of Exhibit Additional Drawing correctly show a cross-section of the connecting rod *d* as the connecting rod is shown in Figs. 1 and 4 of the reissue drawings? If not, state minutely wherein Fig. 6 is incorrect, and explain clearly your reasons for saying so.

Ans. Fig. 6, Exhibit Addition al Drawing, is correct. The slot which forms a guide to the crank *m* should be shown as passing entirely through vertically, while in Fig. 6 of Exhibit Additional Drawing the slot is shown closed at the top and bottom. Figs. 1 and 4 of the drawings of the patent do not show the form of this slot, but merely show a rectangular opening through the piston-rod. The form of the slot is shown in Fig. 2 of the drawings. I have prepared correct drawings which show a corresponding view of this slot and also of the other parts of the meter in section, part of the sleeve being broken away to show the position of the crank-shaft; also showing a perspective view of the operating slot in the piston-rod, with the opening through it. (Witness here produces a drawing which is put in evidence by complainants, and marked Exhibit Donn Drawing, P. B. S., commissioner.) It will be seen from inspection of said exhibit that the slots in which the wrist-pins work are open from top to bottom of the piston-rod throughout, and on the inner side also, but closed on the outside, except where cut through to form the rectangular opening shown by Figs. 1 and 4 of the drawings of the reissue patent. Only one of the rods is cut or formed with this rectangular opening, to wit, the one shown on the right-hand side of said Exhibit Donn Drawing. The rod on the other side of the drawing has not been cut away in this way, nor is so cut away in the Patent Office model from which the drawings were made. The exhibit also shows the relative position of the crank shaft and sleeve through which it passes, the cranks, crank-pins, and gearing for operating the rotary

valve. It is a correct drawing made from the model in the Patent Office.

Cross-int. 19. Assume that Fig. 2 of the reissue drawings was in-
184 tended to show an edge view of the connecting rods *d* with the upper walls of the rectangular slots removed: in that case, would not Figures 1, 2, and 4 of the reissue drawings be in harmony with each other, and with Fig. 6 of Exhibit Additional Drawing, so far as the connecting rod is concerned? If you think not, state fully why not, giving your reasons fully and clearly.

Ans. There are no upper nor lower walls in the slots, and Fig. 2 being a plan view properly shows them open at the top. If, however, they were constructed like Fig. 6 of Exhibit Additional Drawing, that is, with top and bottom closed up, I might assume that a portion had been cut away in Fig. 2 of the reissue. I do not, however, think that the drawings of the patent correspond in any way with Fig. 6 of Exhibit Additional Drawing.

Cross-int. 20. What do you find in the drawings or specification which leads you to believe that *i* is not the crank-shaft, but a sleeve attached to the four-sided piece shown in Fig. 2 unshaded?

Ans. In Fig. 2 of reissue drawings, the crank-shaft is not shown, but the letter *i* indicates the position of the shaft within the sleeve; the shaft is more properly shown in Fig. 1 by the dotted circle marked *i*. Its position is also shown at Fig. 4 by the inner of the concentric circles marked *m*.

Cross-int. 21. What is the purpose of the four-sided piece shown in Fig. 2? Why was it shown in this figure only? State fully, and also explain clearly how you know.

Ans. If you mean by the four-sided piece that part of the meter shown above the valve, it is the frame which supports the sleeve which forms the journal bearing for the crank-shaft. It was not shown in the other figures, because it was not considered necessary, being merely a part of the frame of the meter.

EDW. W. DONN.

Attest:

P. B. STILSON,
Commissioner.

Deposition of Thomas C. Connolly.

Interrogatories propounded by ANDREW McCALLUM, esq., of counsel for complainants.

Int. 1. What is your name, age, residence, and occupation?

Ans. Thomas C. Connolly; age, sixty-four; reside in Washington, D. C.; am a principal examiner in the United States Patent Office.

185 Int. 2. Did you examine the application for letters patent made by Ball and Fitts, and on which they obtained letters patent No. 109372, of Nov. 22, 1870, for improvements in water meters? If you did, please give the history of said application, referring to such of the records of the Patent Office as may be necessary.

(Objected to as incompetent and immaterial.)

Ans. I did. The application was originally filed by the inventors themselves, the application being completed Dec. 9, 1869. The case was examined and rejected Feb. 18, 1870, upon the following claims: "Thus having set forth our invention, what we claim as new and desire to secure by letters patent, first, is, the connecting rods *d*, having slots formed, as shown in combination, with stops *o o*, substantially as set

forth and operating as described; second, is the connecting rods *d* having slots formed as shown in combination with crank *m* and crank-pin constructed and operating substantially as set forth and described." This letter of rejection was addressed by the office to the inventors, Phinehas Ball and Benaiah Fitts, at Worcester, Mass. No action was taken in the case after the rejection, by the inventors, until Oct. 5, 1870, when a power of attorney granted by them to P. Hannay, of Washington City, was filed in the case, under which Mr. Hannay amended the claims, and on the seventh day of October requested a reconsideration of the case as thus amended. The amendments were made by interlineations in the body of the claims originally presented, and were verified and authorized by his prefixing his initials at the side of the claims opposite or in a line with the amendments; and on these amendments the case was passed for issue Oct. 8, 1870. The evidence afforded by the papers and remembrance of the usage of that time have aided me in establishing my convictions upon these points. At this time I do not clearly remember, but my impression is that the changes made in the original claims by these amendments were made at my suggestion. I herewith offer in evidence as an exhibit, to be marked Connolly Exhibit, P. B. S., and appended to my testimony, an exemplified copy of the file wrapper and its contents, which clearly shows the whole transaction, the amendments referred to being enclosed within red lines.

THOMAS C. CONNOLLY.

Attest:

P. B. STILSON,
Commissioner.

186 *Connolly Exhibit.—P. B. Stilson, commissioner, April 9, 1877.*

DEPARTMENT OF THE INTERIOR,
U. S. PATENT OFFICE.

To all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the files of this office of the file wrapper and contents in the matter of letters patent granted Phinehas Ball and Benaiah Fitts, dated November 22, 1870, No. 109372, for imp't in liquid meters.

In testimony whereof I, W. H. Doolittle, Acting Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed this seventeenth day of March, in the year of our Lord one thousand eight hundred and seventy-seven, and of the Independence of the United States the one hundred and first.

[SEAL.]

W. H. DOOLITTLE,
Acting Commissioner.

WORCESTER, MASS., *Nov.* 27, 1869.

To the Commissioner of Patents:

We herewith send you draft for the first fees for our two applications for patents

Namely: Fifteen (15) dollars for the application for improvements in water meters and fifteen (15) dollars for the application for improved piston for water meters.

Yours truly,

PHINEHAS BALL.
BENAIAH FITTS.

To the Commissioner of Patents:

The petition of Phinehas Ball and Benaiah Fitts, of the city and county of Worcester, and State of Massachusetts, respectfully represents that your petitioners has invented a new and useful improvement in water meters, which they verily believe has not been used or known before their invention and use thereof.

They therefore pray that letters patent of the United States
187 may be granted therefor, vesting in them and their legal representatives the exclusive right to the same upon the terms and conditions expressed in the acts of Congress in such cases made and provided, they having paid thirty dollars into the Treasury, and otherwise complied with the requirements of said acts.

PHINEHAS BALL.
BENAIAH FITTS.

COUNTY OF WORCESTER,
State of Massachusetts:

On this thirteenth day of Nov., one thousand eight hundred and sixty-nine, before the subscriber, a justice of the peace in and for said county, personally appeared the within named Phinehas Ball and Benaiah Fitts, and made solemn oath that they verily believe themselves to be the original and first inventor of the within described improvements in water meters, and that they do not know or believe that the same was ever used or known before their discovery and use thereof, and that they are citizens of the United States.

JOHN C. OTIS,
Justice of the Peace.

[5 per cent. J. C. O. J. P. 11, 13, 1869.]

To all whom it may concern:

Be it known that we, Phinehas Ball and Benaiah Fitts, of the city and county of Worcester and State of Massachusetts, have invented a new and useful improvement in water meters, and we do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawings making a part of this specification, in which Fig. 1 is a plan (a portion of the machine being removed to show the inside); Fig. 2 is a sectional view through *x y*, Fig. 1.

It will be seen that this meter is similar in its operation to that patented by P. Ball and B. Fitts, July , 1869; the principal difference being in the slots in the connecting rods in which crank-pins move, and it is these slots in connection with stops at the end of the cylinders that constitutes the peculiar features of this invention.

188 The construction is as follows: *a* is the outside case, *b b* are cylinders set in cement, *c c* are pistons, *d d* are connecting rods, connecting the pistons together, *e* is a slot in the connecting rods. It will be seen that the sides of this slot are not parallel or straight, the slots being wider in the middle than at the ends. *g* is a valve, *i* is the shaft, *m* is a crank, *n* a crank-pin, which moves in slot *e*, *o o* are stops, for the purpose of stopping the pistons when they reach the end of the stroke, *s s* are ports through the valve. The piston, shaft, and valve being so connected together that the valve ports will be open when the piston is in the center of the stroke and closed at the end of the stroke. The operation is a follows:

As the water flows in and moves the piston it will be seen that by the peculiar form of slot *e*, the piston reaches the end of the stroke, and

stops a little before the crank passes the centre (shown by the position in Fig. 2) or the valve ports quite close, the opposite piston then moves the valve over and opens it to the other side of the piston before the crank-pin reaches the point to where the first piston would be compelled to move, and thus in no case would one piston force the other to move while its valve is closed.

Thus having set forth our invention, what we claim as new and desire to secure by letters patent is,

First. The **piston carrying** connecting rods *d* having slots formed as shown, **with concavities to the right and left of the centre,** in combination with stops *o o*, substantially as set forth and operating as described.

Second. The **piston carrying** connecting rods *d* having slots formed as shown in combination with crank *m* and crank pin *n* constructed and operating substantially as set forth and described.

PHINEHAS BALL.
BENAIAH FITTS.

Witness:
JOHN C. OTIS.
ABRAHAM FITTS.

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U. S. PATENT OFFICE,
Washington, D. C., Feb'y 18, 1870.

PHINEHAS BALL & BENAIAH FITTS,
Worcester, Mass.:

Please find below a communication from the examiner: subject, water meter, filed Dec. 9, 1869.

Very respectfully,

Commissioner.

EXAMINER'S ROOM, NO. 96.

The devices claimed by the applicant are believed to be substantially anticipated in the rejected application of M. Warner for a crank movement, July 6, '68, in the patent to J. Sutherland, for a water meter June 2, 1868, and in Fig. 90 of Brown's "507 Mechanical Movements" (Ed. 1868) published by Brown, Coombs & Co., 189 Broadway, N. Y. City. A rejection is declared.

T. C. CONNOLLY, *Ex'r.*
By CHAS. B. PARKHURST, *Ass't.*

Power of attorney.

To the Commissioner of Patents:

The undersigned having, on or about the 9th day of December, 1869, made application for letters patent for an improvement in water meters, which application was rejected Feb'y 18th, 1870, hereby appoint P. Hannay, of the city of Washington, D. C., their attorney, with full power of substitution and revocation, to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent Office connected therewith.

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*The words in italics between stars are enclosed within red lines in the original exhibit, and are interlineations with the initials, P. H., opposite thereto in the left hand margin.

Signed at Worcester, county of Worcester, and State of Massachusetts, this first day of October, 1870.

PHINEHAS BALL.
BENAIAH FITTS.

[50 per cent. P. B. Oct. 1, 1870.]

190 WASHINGTON, *Oct.* 7, 1870.

Commissioner of Patents:

Sir: In the matter of the application of Phineas Ball and Benaiah Fitts for an improvement in water meters filed December 9th, 1870, and subsequently rejected, I hereby, in accordance with the law in such cases made and provided, renew the application and request a reconsideration of the case as amended.

P. HANNAY,
Att'y of P. Ball & B. Fitt

Memorandum of fee paid at U. S. Patent Office: $20, hand; inventor P. Ball & B. Fitts; invention, liquid meter; date of payment, Nov. 5, 1870; fee, $20; solicitor, P. Hannay. Will call for patent.

No. 109372. Phinehas Ball and Benaiah Fitts, of Worcester, county of Worcester, State of Massachusetts.

WATER METERS.

Rec'd Nov. 30, 1869, petition, affidavit, specification; Dec. 9, 1869, drawing; Nov. 30, 1860, model, cert. dep.: Nov. 30, 1869, cash, $15, add'l fee cert.; No. 5, 1870, add'l fee, cash, $20.
Examined October 8, 1870, Connolly.
Issue Grinnell, Oct. 10, 1870.
Patented Nov. 22, 1870.
Recorded vol. , page .
Circular Oct. 10, 1870.

P. HANNAY,
Present.

Rejected Feb'y 18, 1870.
Ex'd H. M. H.
M. C. S.

191 *Complainants' Exhibit Water Committee Vote, J. G. S., Examiner.*

At a regular meeting of the joint standing committee on water, held on the eighth day of May, eighteen hundred and seventy-five, the following vote was passed:

Voted, That the water commissioners be directed to take the readings of W. E. Desper's new meters for one year, except in cases of repeated failure, provided he shall so arrange his stops which will prevent the possibility of being tampered with.

I hereby certify that the above is a true copy of the vote passed by the joint standing committee on water of 1875, said committee consisting of Messrs. D. S. Goddard, G. J. Rugg, George Geer, and T. J. Hastings. Vote on book of records, page 8.

J. STEWART BROWN,
Water Registrar and Clerk.

I hereby certify that J. Stewart Brown is water registrar of the city of Worcester, State of Massachusetts.

Witness my hand and seal of this city this fifth day of March, A. D. 1877.

[SEAL.] E. H. TOWNE,
City Clerk.

192 UNITED STATES OF AMERICA,
Massachusetts District, ss:

I, John G. Stetson, clerk of the circuit court of the United States for the first circuit and district of Massachusetts, certify that the foregoing is a true copy of the record and of all proceedings, including the evidence filed therein, in the cause in equity of the Union Water Meter Company v. William E. Desper et al. in said circuit court determined.

In testimony whereof I hereunto set my hand and affix the seal of said circuit court, at Boston, in said district, this nineteenth day of July, in the year of our Lord one thousand eight hundred and seventy-seven, and of the Independence of the United States the one
193 hundred and second.

JOHN G. STETSON, *Clerk.*

194 *Bond to party on appeal.*

Know all men by these presents that we, the Union Water Meter Company, a corporation duly organized under and in accordance with the general laws of the State of Massachusetts, and located and doing business at the city of Worcester, in the State of Massachusetts, by Phinehas Ball and John C. Otis, respectively the president and treasurer thereof, duly authorized to act in their , as principals, and Phinehas Ball and Benaiah Fitts, both of said Worcester, are held and firmly bound unto William E. Desper, and Henry A. Desper, both of Worcester, in said State, in the full and just sum of five hundred dollars, to be paid to the said William E. Desper and Henry A. Desper, their certain attorney, executors, administrators, or assigns, to which payment, well and truly to be made, we bind ourselves, our heirs, executors, and administrators, jointly and severally, by these presents, sealed with our seals, and dated the seventeenth day of July, in the year of our Lord one thousand eight hundred and seventy-seven.

Whereas lately, at a circuit court of the United States, within and for the district of Massachusetts, in a suit in equity depending in said court between the said Union Water Meter Company, complainants, and the said William E. Desper and Henry A. Desper, defendants, decree was rendered against the said complainants, and the said complainants having obtained an appeal to remove the said cause to the Supreme Court of the United States to reverse the decree in the aforesaid suit, and a citation directed to the said defendants, citing and admonising them to be and appear at a Supreme Court of the United States to be holden at Washington on the second Monday of October next:

Now, the condition of the above obligation is such that if the said Union Water Meter Company, complainants, shall prosecute their said appeal to effect, and answer all damages and costs, if they fail to make

their plea good, then the above obligation to be null and void; otherwise to remain in full force and virtue.

[SEAL OF COMPANY.] UNION WATER METER COMPANY,
By PHINEHAS BALL, [L. S.]
President.
JOHN C. OTIS, [L. S.]
Treasurer.
PHINEHAS BALL. [L. S.]
BENAIAH FITTS. [L. S.]

Signed, sealed, and delivered in presence of—
S. AUGUSTUS WELSH.
ABIEL E. WILSON.

Approved.

J. E. MAYNADIER,
Sol'r for Def'ts.

A true copy of the bond taken by the judge at the time of allowing the appeal named in said bond, which bond is on file in the office of the clerk of the circuit court of the United States for the first circuit and district of Massachusetts.

Attest:

JOHN G. STETSON,
Clerk U. S. C. C. Mass. Dist.

(Indorsement on cover:) No. 209. The Union Water Meter Company, appellant, vs. William E. Desper and Henry A. Desper. Massachusetts C. C. U. S. Filed 3d October, 1877.

SUPREME COURT U.S.
FILED
FEB 23 1880
D. W. SULLIVAN, Clerk

Supreme Court of the United States.

No. 209.

THE UNION WATER METER COMPANY,
Appellant,

vs.

WILLIAM E. DESPER
AND
HENRY A. DESPER.

ARGUMENT FOR APPELLANT,

BY

ANDREW McCALLUM.

BOSTON:
PRESS OF ROCKWELL AND CHURCHILL,
No. 39 ARCH STREET.
1880.

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Supreme Court of the United States.

No. 209.

THE UNION WATER METER COMPANY,
APPELLANT,

vs.

WILLIAM E. DESPER AND
HENRY A. DESPER.

STATEMENT OF THE CASE.

The bill of complaint in this cause was filed in the Clerk's office, U. S. Circuit Court for the District of Massachusetts, December 29, 1875. (Printed Record, p. 1.)

Complainant alleges that the defendants infringe certain letters patent for improvements in liquid meters granted to Ball and Fitts, November 22, 1870, and reissued to complainant March 24, 1874, No. 5,806, and prays for injunction and account of profits and damages (pp. 1, 4).

Defendants filed their answer March 1, 1876, denying infringement and alleging that complainant's patent is invalid (pp. 4, 5).

Replication was filed March 17, 1876 (p. 6). Proofs were taken by complainant and defendants, and the cause was argued by counsel, May 24, 1877, before the Hon. George F. Shepley, late circuit judge of said district, and on June 7, 1877, it was adjudged by the Court that the defendants did not infringe in the manner and form as alleged by complainant in its bill of complaint, a decree dismissing said bill of complaint being ordered (p. 6).

Thereupon complainant appealed to this Court.

Assignment of Error.

The Court erred in deciding that the water meters proved to have been made and sold by the defendants did not infringe complainant's patent as alleged in its bill of complaint.

Argument.

No opinion was filed by Justice Shepley in the cause, and we are not therefore informed as to the reason which led to the decision.

It is believed by complainant that the proofs and the admissions of the defendants are conclusive on the question of infringement, and that therefore the decision of the Court is against the evidence, and could only have been arrived at through failure to fully understand the intricate mechanism embodied in the construction and operation of the machines in question.

As the decision of the Court was based on the question of infringement alone, it is presumed that the other question raised by the pleadings, *i.e.*, the validity of the patent, was determined in favor of the patent; I therefore proceed at once to the consideration of the question of —

Infringement.

In order that the merits of the case on this question may be fully understood it is necessary to consider: —

1. The nature of the invention made by the inventors, Ball and Fitts.

2. The construction and operation of the machine embodying the invention as described and claimed in the patent, the infringement of which is complained of.

3. The construction and operation of the machine made and sold by the defendants, which it is claimed to infringe.

Ball and Fitts' Invention.

This invention relates to a class of machines which are employed for measuring and recording the quantity of liquids which pass through them under pressure, and known as liquid or, more commonly, as "Water Meters," their principal use being to measure water supplied to consumers in our cities.

More particularly the invention relates to that class of water meters known as cylinder and piston meters, the cylinders being employed as measures, and the pistons moved by the inflowing water furnishing the motive-power for the mechanism which opens and closes the ports or channels for the passage of the water, and the mechanism which indicates the quantity measured.

We have, therefore, to consider a machine which operates by the movement of pistons in cylinders, as does the ordinary steam-engine; and, superficially considered, it would seem that all that was necessary to convert a double cylinder steam-engine, with its slide valves, and crank, into a water meter, is to ascertain the capacity of the cylinders, and attach the proper recording mechanism to the crank-shaft, the water under pressure to be measured supplying the motive-power. Apparently that is just what all the inventors who labored in this field of invention prior to Ball and Fitts thought, as is evidenced by the patents of prior date, set up by the defendants in their answer. All of said patents prior to Ball and Fitts' invention, being cylinder and piston meters, having *slide valves*, and arranged to operate substantially in the same way as the ordinary steam-engine; but none of them are of any practical value, because they will not work with water as they do with steam.

Ball and Fitts discovered that engines constructed to operate by means of elastic fluids, such as steam, air, or gas, are not suited for operation by means of a non-elastic, non-compressible fluid, such as water, because in the latter case,

the cylinder can only hold a certain quantity of the fluid, and that quantity cannot be compressed into smaller bulk; therefore it follows, that after the cylinder has been filled, and the piston thereby moved to the end of its stroke, it cannot be moved back again against the water until the port is opened to allow the water to escape. And, as the opening of the port is dependent on the movement of the valve, and the movement of the valve is dependent upon the movement of the piston, the least variation in the adjustment of the parts, or in the length of the stroke of the piston, which might be caused through the wear of the parts, or through the collection of sediment in the cylinders, would cause a complete disorganization of the machine, and if one piston was forced to move by the other, against the water in its cylinder, the result would be that the machine would break or come to a stand-still. The same result would not occur with steam or air as the motive-power, as in such case the only effect would be to compress the steam or air until the port was opened to permit it to escape.

THE NON-COMPRESSIBLE NATURE OF THE FLUID, WATER, WAS THE DIFFICULTY WHICH HAD TO BE OVERCOME IN THE OPERATION OF THESE MACHINES.

In searching for the cause of the trouble, and the means to overcome it, Ball and Fitts first discovered that the slide valves before in use were unfitted for their purposes, and they therefore devised a single rotary valve which was to take the place of the two slide valves before employed.

This was a step in the right direction, as, by the use of the rotary valve, the opening and closing of the ports is not subject to the same exact arrangement and nicety of fitting, nor is it so liable to become inoperative through wear, as is the case where slide valves are used. And, moreover, the one rotary valve serves the purpose of two slide valves, a simplification of the mechanism, which is a great desideratum in all machines.

They took out a patent for a machine embodying this rotary valve, July 20, 1869 (pp. 68–70), but they found the mechanism that they then devised for operating the valve was defective, and that, though not to so great a degree, they encountered the same difficulty with the rotary valve as with the slide valves before employed.

In experimenting with this machine they discovered the cause of failure, reorganized the machine, and provided means to render these cylinder and piston meters practically operative.

They found that the movement of the rotary valve must be made continuous, while the movement of the pistons was alternately arrested at the end of the stroke, for a period of time sufficient to allow the valve to open the eduction port of the arrested piston, SO THAT SAID PISTON IS NOT REQUIRED TO MOVE ON ITS RETURN STROKE, AGAINST THE WATER IN THE CYLINDER, and all danger of breakage, or the stoppage of the machine, in its effort to compress an incompressible fluid, was thereby obviated.

The combination of mechanisms devised by Ball and Fitts for carrying this principle into effect is the invention covered by the patent at issue in this cause.

BALL AND FITTS' PATENT NO. 5,806.

On referring to the specification of the patent (pp. 9–14), we learn that the improvement relates to a new and improved mode of operating that class of water or fluid meters in which two or more cylinders, each provided with a reciprocating piston, are combined and used in connection with a single rotary valve, whose ports are common to the water-ways of the different cylinders (p. 10, top), and that the invention consists in combining the rotary valve with certain other mechanical elements, which together co-act to produce the desired results. There are eight different combinations claimed in the patent, two of which, to wit, the second and

fourth, the expert, Mr. Hervey Waters, found to be embodied in the construction of the defendants' machine (pp 24–26).

For the purpose of this argument, however, I will only refer to the fourth claim, as it embodies all the mechanism employed in the construction and operation of the machine (p. 13).

An analysis of this claim shows it to be for a combination of five mechanical elements, each having its peculiar function, and all coöperating to produce the required result. These elements or mechanical instrumentalities are as follows: —

1. A rotary valve, *g*, provided with suitable ports or openings through which the liquid to be measured can be supplied to the meter and discharged therefrom.

2. Cylinders, *b* and b^1, for the reception and measurement of the liquid.

3. Double-acting pistons, *c* and c^1, each carrying a rod, *d*, and each of said rods provided with a single cam slot, *e*, arranged as described, and of a width greater than the diameter of the wrist, *n*, of the crank-shaft, so as to permit of the adjustment of the pistons that they may discharge at each stroke as nearly as possible the exact quantity of water required of them, and so as to allow each of the crank-wrists, *n*, freely to pass its dead centre after its own piston has ceased to act on it.

4. Adjusting stops, *o*, by means of which the adjustment of the length of the stroke of the pistons at either end is effected.

5. A crank-shaft, *i*, through which motion from the pistons is imparted to the valves.

The functions of these several elements are fully described in the specification, and may be noted as follows: —

The rotary valve, with its ports, at the proper time, allows the water to flow into the cylinders to be measured, and to pass out after it is measured.

In the specification it is stated that "the rotary valve itself may be of any suitable construction, so long as it is provided with the necessary ports, through the channels f and f^1, to supply the liquid to and discharge it from the cylinders when measured." (p. 11).

Its essential features are its being provided with the proper ports, arranged to open and close at the right time to allow the water to pass into and from the cylinders. The particular construction of the valve is immaterial so long as it embodies these essential features.

The function of the cylinders is to measure the water.

The function of the double-acting pistons is to provide motion for the operation of the machine, the motive-power being the water or liquid which passed into the cylinders, and acts alternately on the pistons which are connected by the piston-rod.

The function of the slot in the piston-rod is to receive the wrist-pin, and, through contact with its walls, impart motion to the crank-shaft.

The function of the crank-shaft is to convert the reciprocating motion of the pistons into a rotary motion for the operation of the valve.

All these parts, therefore, co-act to produce the required movements of the machine; but that is not all, — the slot in the piston-rod is made of greater width than the diameter of the wrist-pin, and that width is still further increased on each side at or near its centre (p. 11).

This feature of the slots, their being made considerably wider than the diameter of the wrist-pin, is one of very great importance in the operation of the machine, as we shall presently see.

The function of the stops, o, is to adjust "the length of

the stroke of the piston so that each cylinder shall discharge alternately, for each stroke of its double-acting piston, as nearly as possible, a given quantity of water, and no more; and, in addition to this, we so arrange the crank and valve ports with relation to each double-acting piston that the latter will reach the end of its stroke and be arrested by the stop, *o*, before its valve ports quite close" (p. 12, top).

These stops arrest the motion of the piston before it reaches what would otherwise be the end of the stroke, and the arrangement of the stop is such that, when the piston is thereby arrested, the wrist-pin of the crank-shaft at the same time loses contact with the wall of the slot in the piston-rod, and the motion of the crank-shaft being continued by the piston pertaining to the other cylinder which is being filled, carries the wrist-pin pertaining to the piston which has been stopped over the dead centre, without resistance of any kind, there being nothing opposed to its passage at this critical point; and the result is, that the crank-shaft passes the dead centre and operates the valve to open the ports for the escape of the water from the cylinder last filled, and its admission to the one to be filled, before the wrist-pin resumes contact with the wall of the slot in the piston-rod.

The operation is the same, whether the pistons are forcing the crank-shaft to move, or either of them is forced to move by the crank-shaft through the operation of the other piston,—a result of the greatest importance in the operation of this class of water meters.

It is therefore apparent, *first*, that the rotary valve is a feature essential to the successful operation of the meter; and, *second*, that the stopping of the pistons to permit of the crank-pins to pass the dead centre without contact with the rods, and which is accomplished through the stops, *o*, and the widened slots in the rods, is a condition essential to the proper working of the rotary valve.

These features of the machine, the rotary valve, the stops,

and the widened slots in the piston-rods, when combined to operate with the cylinders and pistons, constitute the invention claimed to be infringed by the use of the defendants' machine.

The principle of operation, it will be observed, is not broadly claimed in this patent, nor are the mechanical elements or devices claimed when separately considered; but the combination of these devices when operating together to produce a common result is claimed, and being the first to embody a combination of devices which will produce the required result, we claim that the patent covers broadly the same combination of elements, whether the construction of the mechanism or devices which constitute the individual members of the combination are of the same or of different construction.

"Equivalents are allowed in an invention consisting of a combination of old ingredients as well as in every other class or description of inventions."

Storrs *vs.* Howe, Off. Gaz., Vol. 10, p. 421. Clifford J. 1876

"*Bona-fide* inventors of a combination are as much entitled to equivalents as the inventors of other patentable improvements."

Gould *vs.* Rees, 15 Wallace, 187.
Robertson *vs.* Blake, Off. Gaz., Vol. 11, 877. 4 Otto 728

Defendants' Machine.

On comparing the machine made and sold by the defendants with complainant's patented machine, they would seem, on a casual inspection, to be of different construction. In appearance they are quite dissimilar, and, without careful examination of the construction and operation of the mechanism employed in both, they might be considered materially different machines.

The difference in appearance arises from the fact that the cylinders of defendants' machine are arranged at right angles

to each other, instead of being parallel, as in complainant's machine.

That difference in the arrangement of the cylinders is the only real difference between them. Of course, the arrangement of the cylinders at right angles to each other involves a corresponding difference in the arrangement of the pistons and rods which connect them. The piston-rods must of necessity cross each other on different planes; and the crossing of the rods brings the slots together in the centre of the machine, so that one crank-pin made long enough to pass through the slots of both piston-rods serves the same purpose as the two crank-pins rendered necessary when the pistons are arranged to move parallel to each other, as in the complainant's machine. In both cases, however, the piston-rods, with their widened slots, act upon the crank-pin in precisely the same manner, converting the reciprocating motion of the pistons into a rotary motion of the crank-shaft which moves the rotary valve.

Another difference arising from this difference in the arrangement of the cylinders in the two machines is that gearing is dispensed with for operating the valve of defendants' machine; but, as a consequence of this arrangement, the valve of defendants' machine is required to rotate three times as fast as the valve in complainant's machine, — thereby increasing the wear through friction, without gaining any advantage.

The differences between the two machines are, therefore, mere differences in the arrangement of parts, not involving any new principle in the operation of the machine, or productive of any new or improved result.

"If the machine used by the defendants, in its structure and operation, is substantially the same with the plaintiff's invention, as patented, though different in form and arrangement, it is an infringement of his patent."

Wyeth *vs.* Stone, 1 Story, 280.
Root *vs.* Ball, 4 McLean, 180.
Parker *vs.* Haworth, 4 McLean, 373.
Sickles *vs.* Borden, 3 Blatch., 541.
Sargent *vs.* Larned, 2 Curtis, 349.

"In order to constitute an infringement, it is not necessary that the arrangement and combination of the party charged with infringement should be the same to the eye or in point of fact.

"If they embody the ideas of the patentee, and the machinery of the defendant operates by such adoption and appropriation, then, though the arrangement may be apparently different, in reality and in judgment of law an infringement exists."

Smith *vs.* Higgins, Nelson, J., N. Y., 1856, Law's Dig., 369.

"It is immaterial that the form of his journal-bearing arm is unlike that of complainant's so long as it performs the same function in substantially the same way

Mason *vs.* Graham *et al.*, Off. Gaz., Vol. 7, 832
See also Vincent Refinery *vs.* Matheson, 2 Fish
Evans *vs.* Eaton, 3 Wash., 449.
Buerk *vs.* Valentine, Off. Gaz., Vol. 2, 295.
Hamilton *vs.* Ives *et al.*, Off. Gaz., Vol. 3, p. 3
Converse *vs.* Cannon, Off. Gaz., Vol. 9, p. 105

Considered in the light of these rulings, [illegible] pears to be fully established by the proofs.

The elements, or mechanical devices, and their operation are substantially the same in both machines. (Fitts' deposition, pp. 15, 16; Hervey Waters' deposition, pp. 24–26.)

The infringement is virtually admitted by the defendants and the testimony of their expert. (See deposition of Daniel C. Fisher, p. 44, and Wm. E. Desper, p. 62, mid.)

The last-named witness, one of the defendants, is asked by his counsel: —

"*Int.* 7. Compare your meter (Exhibit 6) with the meter described in the Ball and Fitts reissue No. 5,806, and exemplified in Exhibit 5; and state what, if anything, you find in common between them which is not also found in one or more of the meters described in the prior patents referred to in the last question.

"*Ans.* The parts common to both Exhibits 5 and 6 are: two cylinders, two double-acting pistons, two connecting rods, adjustable stops, and a rotary valve. The piston-rods in both cases have slots. In Exhibit 5 the slots are narrow at their ends, having concavities at their middle; the slots in Exhibit 6 are the same width throughout their length.

"I find all these devices in the aggregate of the patents before referred to, but not in any one of them."

This witness is testifying in the triple capacity of a mechanical expert, a practical machinist, and in his own interest as defendant.

The only difference he finds between the machine made and sold by him and the one described in complainant's patent, as exemplified by the machine Exhibit 5, is that in his machine the slots in the piston-rods are of equal width throughout their length, while in complainant's machine the slots are wider in the middle than at the ends; and when we show that this difference is in no way material to the successful operation of the machine; when we show that one of the main elements of success lies in having the slots made wider than the diameter of the wrist-pin, so as to allow the latter to move for a time in space without contact with the piston-rod; and when we show that the defendants' machine as constructed differs in this respect from the patent under which they seek to justify the infringement, — we must insist that the defendants are *knowingly and wilfully infringing the rights secured to complainant.*

The concluding portion of the answer of Wm. E. Desper referred to, to wit: —

I FIND ALL THESE DEVICES IN THE AGGREGATE OF THE PATENTS BEFORE REFERRED TO, BUT NOT IN ANY ONE OF THEM — is also a material admission in another respect, as by the context it will be seen that "the patents before referred to" are the patents of prior date set up in the answer as anticipating the invention claimed in reissued patent No. 5,806, on which this suit is brought, and therefore it is an admission that the same combinations of devices embodied in the construction of complainant's machine are not found in any patent of prior date; and hence the invention of Ball and Fitts is not anticipated in any prior patent.

The proof as to the identity of the mechanical elements which constitute the combinations claimed is, we submit, conclusive on the question of infringement.

The proof as to the non-essential nature of the differences found to exist in the two machines is equally conclusive.

With regard to the difference in the form of the slot, see deposition of Fitts, p. 23, Waters, p. 25, bot., and 29.

With regard to the difference in the valve, see Fitts, p. 21; Waters, p. 27, bot., 28, top, and 30, mid.

Defendants' expert, Fisher, tried to make out that there was no crank-shaft in defendants' meter (p. 36, mid.), but he admits that the sketch exhibit (p. 43) represents a crank-shaft, and that is precisely the device employed in defendants' meter for rotating the valve; the valve itself being attached to or cast with the portion of the shaft marked *a*, as will be clearly apparent on inspection of the device itself.

Evidently Mr. Fisher's knowledge of mechanics is not very great, or his opinion as an expert is not reliable.

Henry A. Desper, one of the defendants, denied that they used the stops in their meter for adjusting the length of the stroke of the piston, which is one of the functions of the stops as described in complainant's patent; but this is disproved by the testimony of Davis (p. 86).

Desper also denied having made and sold any meters in

which the slots in the piston-rods were of unequal width throughout their length; but this is disproved by the testimony of the same witness (Davis, p. 87), and the meter produced by him marked "Complainants Exhibit Davis, No. 2." So that it is proved not only that the combination of mechanical devices claimed in complainant's patent is found embodied in defendants' machine in all its essential features, but even in minor and non-essential respects; so far as the scope of the claim is concerned, the defendants have been adopting the construction of parts described in complainant's patent in order to secure the best results in the operation of their water meters.

Validity of the Patent.

In view of the proofs there can be no doubt as to the novelty of the invention made by Ball and Fitts. There does not appear to be room for any argument on this question. The facts are as follows :—

Of the prior patents set up in defendants' answer, the Ericsson, Sutherland, Spencer and Meyer, and Barden, all show and describe cylinder and piston meters having *slide valves* arranged to operate on the principle of the steam-engine. They all lack the essential element of the combination claimed by Ball and Fitts, to wit, *the rotary valve;* and this of itself is sufficient proof that these patents do not anticipate Ball and Fitts' invention.

The only prior patent cited by defendants, which shows a rotary valve, is the Ball and Fitts patent of 1869, before referred to, and while that machine has the rotary valve, it does not have the stops for arresting the motion of the pistons, and for adjusting the length of their stroke, nor does it have the widened slots in the piston-rods, to allow the crank-pins to pass the dead centre without contact,—features which are undoubtedly most essential to the operation of the Ball and Fitts machine, described in patent No. 5,806.

The proofs offered by defendants on this question confirm these facts.

The witness, Fisher, was not asked anything about the Sutherland, Spencer and Meyer, or Barden patents, and with regard to the Ball and Fitts 1869 patent, all he was asked was, if the valve described in that patent was the same as the valve in the patent in issue (p. 35, bot.), a matter which is not disputed.

All he is asked respecting the Ericsson patent was, if it showed slots in the piston-rods wider than the diameter of the wrist-pin (p. 35, bot.).

On cross-examination he asserts that adjustable stops are described in said Ericsson patent, but on being asked to refer to said description in the patent, he fails (p. 45, top). Slide valves are used (p. 45, mid.), and he admits that the device, as constructed, would be inoperative in his opinion (p. 45, bot., 46, top).

The witness, H. A. Desper, was examined on this question respecting all of said prior patents, and finds some of the elements of the combination in each (p. 50).

On cross-examination he says, respecting the Ericsson patent, that it has two slide valves, such as are used in high pressure steam-engines, and that such valves could not be used in connection with a machine like Ball and Fitts machine, *without further invention* (p. 57, top).

The Sutherland patent, he admits, has two slide valves; it does not have the widened slots, nor does it have stops to limit the motion of the pistons (p. 57). The Spencer and Meyer machine has two slide valves, no widened slots or stops, or means for adjusting the length of stroke of the pistons (p. 57, bot.). The Barden patent has two slide valves, no slots in the piston-rods, and no stops for adjusting the stroke of pistons (p. 58, top). The Ball and Fitts 1869 patent has different means for operating the valve, has no adjusting stops, etc. He *would have to invent a little* to make the 1869

machine into the machine described in the patent in issue (p. 58, bot.).

The witness, W. E. Desper, as before noted, says in respect to these prior patents, as compared with complainant's machine, "I find all these devices in the aggregate of the patents, before referred to, but not in any one of them" (p. 62, mid.).

An admission which we submit is conclusive proof that neither of the prior patents set up by the defendants anticipate the Ball and Fitts machine.

Complainant's proofs in rebuttal on this question clearly show that the same invention is not embodied in any of these prior patents.

With regard to Ball and Fitts 1869 patent, see deposition of Hervey Waters, pp. 100–101; Fitts, p. 93.

With regard to Sutherland patent, see Waters (p. 102. bot.).

With regard to Spencer and Meyer patent, see Waters (p. 103).

With regard to Barden patent, see Waters (p. 103, bot).

With regard to Ericsson patent, see Waters (p. 101, bot., and 102, top).

In brief, neither of the patents of prior date, referred to by the defendants, shows the same combinations claimed by Ball and Fitts in their entirety. The elements or mechanisms separately considered may be found in other machines, but the combination is certainly not shown in any one of them.

"Patented combinations are to be regarded as entireties, and cannot be defeated or avoided by showing the separate elements to be old in other relations and combinations."

Williams *vs.* Rome, Watertown & Ogdensburg R.R., Off. Gaz., Vol. 15, p. 653. 1 Blatchford J. 1879
See also Foote *vs.* Silsby, 2 Blatchford, 270.
Hovey *vs.* Henry, 3 West. Law Jour., 154.

ALLEGED INVALIDITY OF THE REISSUE.

The only averment in the defendants' answer which raises this question is, that the reissued patent is for the invention or improvement described in and covered by the Ball and Fitts patent of 1869 (p. 5).

It is not alleged in the pleadings that the reissued patent is void because of new matter having been introduced into the specification, but that it is void because the invention claimed in the reissued patent is the same as in the 1869 patent.

The proofs herein noted are ample and conclusive that the two patents are for different inventions, and no further argument would seem to be necessary on this point; but the defendants have sought to raise an issue not pleaded, and which appears, judged by the nature of tne testimony, to be the main defence relied upon.

The theory of the defendants in this respect is that the model filed in the Patent Office forms no part of the patent, and that a fuller description of the devices represented in the model than is given in the specification of the original patent is not permissible in the specification of a reissued patent; for instance, defendants claim that because the adjustable feature of the stops shown by the model was not fully described in the original patent, their description in the specification of the reissued patent is new matter, and because of such new matter the reissued patent is void on its face.

This whole argument rests upon the erroneous premises that the model forms no part of the patent.

"Models and drawings are to be considered and taken together, in explanation of the specifications of a patent.

Stephens *vs.* Solesbury, Law's Digest.

Models and drawings are a part of the letters patent, and

may be resorted to for clearer information, respecting the invention described in the specifications."

Hogg *vs.* Emmerson, 6 Howard, 485.

The specification of reissued patent No. 5,806 contains nothing which is not shown by the model filed with the application for the original patent. The specification of the original patent was defective in that it did not fully describe the construction and operation of the machine shown by the model; under such circumstances it is at once the right, and the duty, of the patentee to surrender his patent, and have it reissued on more perfect specifications.

"Surrenders are allowed, in order that what was imperfect before may be made perfect, and in order that what was before ambiguous may be made clear and certain; and for that purpose the patentee may add whatever was substantially suggested or indicated in the original specifications, drawings, or Patent Office model. New features may not be introduced, for the reason that every interpolation of the kind is forbidden by the act of Congress.

Errors and defects may, however, be corrected, under the conditions specified, and the prohibition that new features shall not be introduced must not be understood as taking away the right to include in the reissue whatever was substantially suggested or indicated in the surrendered specifications, drawings, or Patent Office model.

Stevens *vs.* Pritchard, Off. Gaz., 10–505. Clifford J. 1876
Herring *et al. vs.* Nelson *et al.*, Off. Gaz., 12–753. Johnson J. 1877

As there is nothing described in this reissued patent No. 5,806 which is not substantially suggested or indicated in the surrendered specifications, drawings, and Patent Office model, the patent is valid under the above ruling.

The claims of the reissued patent, though greater in number, are of more limited scope than the claims of the

original patent. They embrace combinations including a greater number of parts, or elements, than the claims of the original patent, and therefore the patent is not open to the objection that it has been expanded so as to cover combinations of fewer elements, or by the omission in the claims of elements which formed essential features of the combinations claimed in the original patent.

Another objection raised by defendants, but which is not included in the pleading, is that the drawings of the reissued patent are imperfect in some respects.

There is no pretence that the specification is not in such full, clear, and exact terms, as will enable those skilled in the art to make and use the invention; and, even if there was, there is no such issue raised by the pleadings, so that defendants cannot now avail themselves of such a defence.

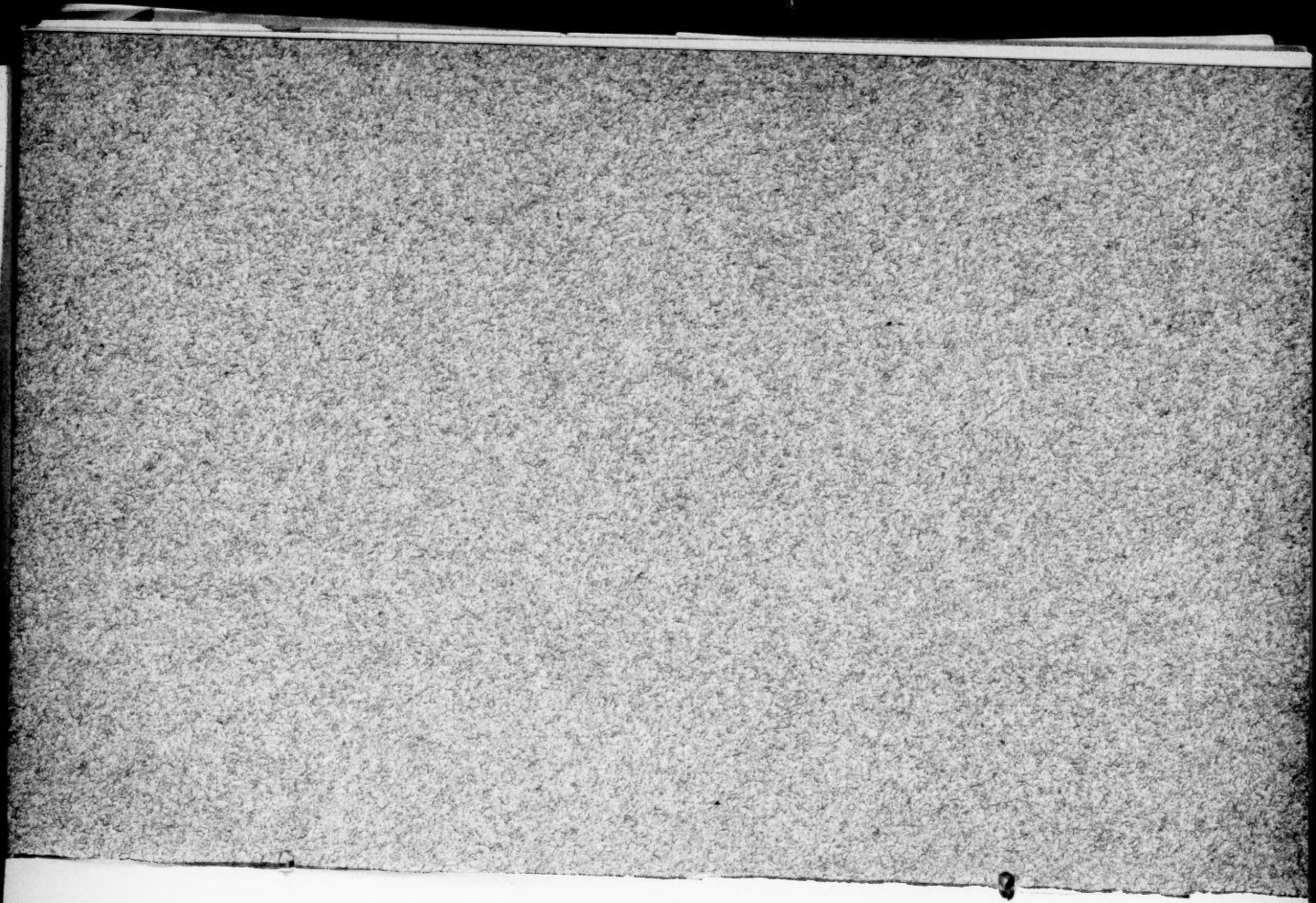
There is a slight inaccuracy in the drawings, or rather in designating them. "Fig. 1" ought to be "Fig. 2;" the draftsman having improperly transposed the designating numbers, and in one of the figures he failed to indicate the full length of the slot in the piston-rod by dotted lines; but the error, if such it be, is of so trivial a nature as to deceive no one, and is hardly discoverable.

The fault is certainly not with the complainant, but is due to the carelessness of the Patent Office, the drawing having been made from the model by the chief draftsman, the inventor, under the rules of that office, not being permitted to withdraw the model for the purpose of making drawings from it.

For the draftsman's explanation of the inaccuracies referrred to, see Record, p. 113. This objection is considered too trivial to require further notice. A comparison of the drawings with the model, as filed in the Patent Office, will satisfy the Court that they are correct in all essential particulars, and properly represent the device described in the specification.

Defendants' machine undoubtedly embodies in its construction the same combinations of parts set forth and claimed in the second and fourth claims of complainant's reissued patent No. 5,806; the parts operate in the same manner and produce the same result; the differences in the arrangement of parts in the two machines are mere formal variations, productive of no new result, and therefore the two machines are the mechanical equivalents of each other. Defendants have presented no proper defence. We submit that the court below erred in deciding that the defendants did not infringe, and that the decree should therefore be reversed, and the defendants enjoined and ordered to account, with costs.

ANDREW McCALLUM,
Counsel of Complainant.



OFFICE SUPREME COURT
FILED
MAR 17 1880
W. MIDDLETON

Supreme Court of the United States.

No. 209.

THE UNION WATER METER COMPANY,

Appellant,

vs.

WM. E. DESPER AND HENRY A. DESPER,

Appellees.

BRIEF ON BEHALF OF APPELLEES.

WORCESTER:
PRINTED BY EDWARD R. FISKE & SON,
1880.

Supreme Court of the United States.

No. 209.

THE UNION WATER METER COMPANY,
Appellant,

vs.

WILLIAM E. DESPER and HENRY A. DESPER,
Appellees.

Brief on Behalf of the Appellees.

It was decided by the late Mr. Justice Shepley that the defendants did not infringe Re-issue No. 5806 dated March 24th, 1874, (pp. 9 to 14,) and the main question now is as to

INFRINGEMENT.

The meter described in the Re-issue is made up of the following elements:

Two parallel cylinders, two pairs of pistons, one pair in each cylinder, two piston rods, each rod connecting together the two pistons in each pair, and each rod provided with a slot across it, a crank shaft with a crank at each end, the wrist pin of one of these cranks lying in one of the slots, and the wrist pin of the other lying in the other slot, a pinion on the crank shaft, between the two cranks, a gear wheel meshing with this pinion, a rotary valve, and a casing with suitable water ways; the gear wheel

and the valve being so mounted that they turn on the same axis, that is, are both fast on the same shaft; and in addition, stops, and a relation between the diameter of the wrist pins and the width of the slots, which will be more fully stated below.

What is new, if anything, in this contrivance?

It is clear that the Ball & Fitts '69 patent (pp. 68 to 70) describes a meter with (1) a valve, (2) cylinders, (3) pistons, (4) rods, (5) slots, and (6) a crank shaft with a pinion meshing into a gear on the valve; and all these elements are identical with the corresponding elements in the re-issue except the fifth, which is substantially different. Viewed as an improvement on the Ball & Fitts '69 patent, the invention of the re-issue patent consists in introducing a different means of causing the reciprocation of the piston rods to actuate the crank shaft.

But this very means was old and well known, not only as a matter of general knowledge among mechanics, but as applied to two piston rods, as the means for causing them to actuate the two cranks of a crank shaft, which crank shaft actuated the valves in a water meter; see the Ericsson patent pp. 71 to 75.

These two prior meters show clearly that this re-issue cannot be valid, if it be construed to cover the defendants' meter; for the entire invention of Ball & Fitts (so far as this question is concerned,) consists in an improvement on the Ericsson meter, by substituting for the slide valves, and the eccentrics on the crank shaft, and the connecting rods, by means of which the motion of the crank shaft is communicated to the valves,—by substituting for this machinery a rotary valve, and a pinion on the crank shaft, and a gear on the valve; but inasmuch as in both the re-issue and the Ericsson patent there is a crank shaft, with two cranks, operated by the two slotted piston rods, and in both the motion of the crank shaft is communicated to the valve or valves, the features distinguishing the re-issue meter from the Ericsson are the use of the pinion and gear as distinguished from the eccentrics and their connecting rods, for operating a rotary valve instead of for operating slide valves.

But on reference to the Ball & Fitts '69 patent it will be seen that the entire invention of the patentees, so far as this case is concerned, may be stated in either one of two ways; (a) as an improvement upon the Ericsson patent by substituting for the

eccentrics, connecting rods and slide valves, the pinion, gear and rotary valve of the Ball & Fitts '69 patent; or (b) as an improvement upon the Ball & Fitts '69 patent, by substituting for the piston rods and the pins there shown, the piston rods and wrist pins of the Ericsson patent.

All these facts are clear upon inspection and are not disputed; (see pp. 100 to 102, especially near the bottom of page 101, and 5 p 102; 34 to 36 pp. 109 to 111;) and the defendants submit that it necessarily follows from them that the Desper meter does not infringe the re-issue, for the reason that it does not embody the improvement above mentioned no matter how stated; that is the invention embodied in the Desper meter may be stated in either of these two ways: (a) as an improvement upon the Ericsson by substituting for the following parts, viz: (1) the crank shaft, (2) the two cranks and their wrist pins, (3)the eccentrics on the crank shaft, (4) the connections between these eccentrics and the valves, and (5) the slide valves,—by substituting for these five parts two parts only, (1) a wrist pin, (2) a rotary valve; the single wrist pin taking the place of both the cranks and both the pins in the Ericsson, nothing whatever being substitued for the crank shaft, the eccentrics, their connections and one of the two crank arms and wrist pins; and this improvement was made possible only by a totally new arrangement of the cylinders, piston rods and their slots, across each other, instead of parallel, as in Ericsson, Ball & Fitts '69, and the re-issue; or (b) as an improvement upon the Ball & Fitts '69 patent, by substituting for (1) the parallel cylinders, (2) piston rods, (3) the cross shaft, (4) disks, (5) pins, (6) slots in the piston rods, (7) the gear, and (8) pinion;—by substituting for these eight parts, the following parts, viz: (1) crosswise cylinders, (2) piston rods, (3) slots across the rods, as in the Ericsson, but at right angles with each other, (4) a single wrist pin applied directly to the valve; substituting nothing whatever for the crank shaft, its disk and pins, nor for the gear and pinion, unless the single wrist pin be regarded as a substitute for the crank shaft, disk, pins, pinion and gear.

Or more briefly: the re-issue invention is in essence the combination of two cylinders and pistons, two slotted piston rods,

and a rotary valve, by means of a crank shaft with a crank at each end, a pinion on the crank shaft and a gear on the valve; while Desper's invention is the combination of two cylinders and pistons, two slotted piston rods and a rotary valve by means of a single wrist pin projecting from the valve. Desper crossed his two cylinders and piston rods instead of having them parallel, and thereby rendered useless the crank shaft, the two cranks, the pinion and the gear on the valve.

The defendants had as good a right to improve upon the meters shown in the Ericsson and Ball & Fitts '69 patents, as the complainants had; and the defendants' improvements are radically different from any described in the re-issue; the main object of the defendants being to dispense wholly with the crank shaft, and mechanism to connect it with the valves, and to move the valve by connecting it directly with the slotted piston rods; while the main object of the complainants was to substitute the pinion and gear for the eccentrics and their connecting rods.

The only real likeness between the complainants' and defendants' meters is that both embrace the good points of the meters described in the Ericsson and Ball & Fitts '69 patent; but as to the plan for combining these two good features (i. e. the rotary valve and the cross-slotted piston rods,) and the means used to effect their combination the defendants' and complainants' meters are radically different; and inasmuch as the whole invention embodied in complainants' meter consists solely in a certain plan for doing this, by certain means, (i. e. by retaining the crank shaft with its two crank arms and wrist pins, and connecting it by gears to the valve,) the complainants have no just ground of complaint because the defendants have improved upon the Ericsson meter by discarding the crank shaft with its two crank arms and wrist pins and all mechanism between it and the valve, and by reason of an extremely ingenious arrangement of the slotted piston rods caused them both to act upon a single wrist pin secured directly to the valve.

It is clear also that the Ericsson patent shows adjusting stops, p. 71, last paragraph, and p. 72; that is to say, if the eccentrics on Ericsson's crank shaft and their connecting rods and the slide valve be removed from the Ericsson meter, and the pinion, gear and rotary valve of the Ball & Fitts '69 patent be substituted, the

meter thus made will embody the combination of the fourth claim of the re-issue.

The stops shown in Ericsson are not the same in construction as those in the re-issue, but neither are the stops in defendants' meter. Mr. Waters makes the point that these stops are adjustable in the re-issue and not so in Ericsson's patent; but, assuming this, it does not follow that the defendants' meter infringes this fourth claim, for the reasons above fully stated as to infringement generally.

The complainants' case as to infringement is based upon the notion that if their meter was the first in which a particular kind of piston rod, (the Ericsson,) was used with a particular kind of valve, (that shown in the Ball & Fitts '69 patent,) they are entitled to cover all meters in which this kind of rod and this kind of valve are used; and in like manner if their meter was the first in which this kind of rod, this kind of valve and adjusting stops were used, they are entitled to cover *all* meters in which this kind of rod, this kind of valve, and adjusting stops are used. The defendants submit, most confidently, that the proof that this kind of rod was old, and that this kind of valve was old, restricts the complainants to their manner of combining them, for the reason that all that they invented was the manner of combining them, and their patent can be no broader than their invention; and so of the stops.

Moreover the slots of the connecting rods operate upon the wrist pins of the cranks precisely the same, whatever valve be used; and the relation of the widened slots, wrist pins and stops is precisely the same whatever valve be used.

To hold that the complainants can monopolize all meters having the slotted piston rods, and a rotary valve, would be to make their patent cover a mere idea or result; that is to say, the value of slotted piston rods and of rotary valves in a water meter is nothing without *means* for combining these elements, and it was only when Ball & Fitts invented these means (the crank shaft, with its two cranks and with a pinion between the two cranks and a gear attached to the valve,) that they became entitled to their patent; for they made no invention whatever (over the Ericsson and Ball & Fitts '69 patent) until they had devised this combination of crank shaft, two cranks, pinion on the shaft, and gear on the valve.

This argument holds *a fortiori* as to the combination of slotted piston rods, rotary valve and stops.

The second claim, it is submitted, must be construed to cover in substance a meter in which the two slotted piston rods are connected to a rotary valve by means of a crank shaft, two cranks, pinion and gear, or by means which are the equivalents of these means; and the fourth claim as for the subject matter of the second claim with the addition of the stops.

Under this construction it is submitted that the defendants' meter does not infringe either of these claims, because the defendants' meter does not contain the crank shaft, cranks, pinion or gear, or any equivalent for either; and because the defendants' meter is an independent invention; in which there is not even a trace of any improvement of Ball & Fitts over the Ericsson patent, or over the Ball & Fitts 1869 patent.

The first, third, and fifth claims of the re-issue (pp. 12 and 13) are for inoperative combinations, unless the first be construed to be the same as the second, the third the same as the fourth, and and the fifth the same as the sixth; and all that has been said as to the second and fourth applies to the first and third. The fifth, sixth and seventh claims are for precisely what is fully described in the Ericsson patent; that is, the combination of the slotted piston rods, the slots being of a width greater than the diameter of the wrist pins, with adjusting stops, crank shaft, pistons, cylinders, water ways and a suitable valve or valves.

The eighth claim is for the invention described in the original patent.

The second defence is that the Re-issue is not for the same invention as the original.

On this point it is clear that the re-issue is vastly more ambitious than the original. The following points seem too clear on inspection to need argument: There is no hint in the original that the slots are to be essentially wider than the diameter of the wrist pin, except where cut away to form "concavities:" but this widened slot is shown in the drawings of the re-issue and dwelt upon in the description. This alteration in the drawings, the assertion in the description that the "general width of the slot" is "somewhat greater than the diameter of the wrist pin," the purpose ascribed to this slot widened throughout, (viz. to admit

of adjustment of the stroke for the purpose of affecting the quantity of water discharged,—the true and only purpose of the stops being to so regulate the length of stroke that the slots would not bring up against the crank pins,—see p. 12;) and the addition of the third, fourth, fifth, sixth and seventh claims, it is submitted make the re-issue void.

The fact is, that the only novelty the inventors ever thought of, until after they obtained their original patent, was the peculiarly shaped slots, fully described in the original patent; but after Desper showed them that this peculiarly shaped slot was not essential in the Desper meter, they repudiated this peculiarly shaped slot; and now claim the Ericsson slot. This is submitted as clear on comparison of the original and reissue.

It will be clear on inspection that the only purpose ascribed to the stops in the original patent was to arrest the motion of the piston just before the crank reached the dead centre, so that the wrist pin might pass freely by, without grinding upon the walls of the slot, the concavities allowing this; and that it was necessary with this kind of slots to have some means of adjusting the length of the stroke to the length of the crank arm. And it is clear that if the wrist pins fitted these slots as wrist pins usually fit slots, except at the "concavities," that this is all that these stops could do.

It is also clear on inspection that the drawings of the reissue differ considerably from those of the original; one difference being that the slots are shown considerably wider than the wrist pins especially at the bottom of Fig. 2, of the reissue.

Another difference is that the slots are shown as rectangular in figures 1 and 4, and as closed at the bottom in Fig. 2; Fig. 6 of Exhibit additional Drawing (p. 114) being a correct cross section of the piston rod as shown in the reissue drawings. The meter would of course be wholly inoperative with piston-rods of this kind. The crank-shaft in both the original and reissue patents is shown as without any bearings; figure 5 of Exhibit Additional Drawings shows the crank-shaft in detail as it is represented in the drawings of the reissue.

The two circles marked *n* in Fig. 4 of the reissue drawings are misleading; and so also is the peculiar shape of the gear wheel shown in Fig. 2.

The testimony is full as to these defects in the reissue drawings; and the defendants confidently submit that it is clear from inspection, as well as proved by the testimony of Fisher, the two Despers, Fitts, Gibbs, Waters and Donn, that any mechanic who attempted to construct a meter from the reissue, would be hopelessly misled by the drawings, and by the assertion in the specification that *i* indicated the crank shaft, and that no mechanic could construct the meter from the patent.

As to the question of "new matter" the defendants submit that this defence, if sustained, invalidates the whole patent; that is to say that the saving clause of the statute, providing that a patent with one or more void claims shall yet be held valid if any of the claims be good, is not applicable to a reissue in which there is "new matter;" but that the patent is void *in toto* although but one of the claims be for an invention not described, suggested or substantially indicated in the original as a part of the invention.

Respectfully submitted

by J. E. MAYNADIER,

of Counsel for Defendants.